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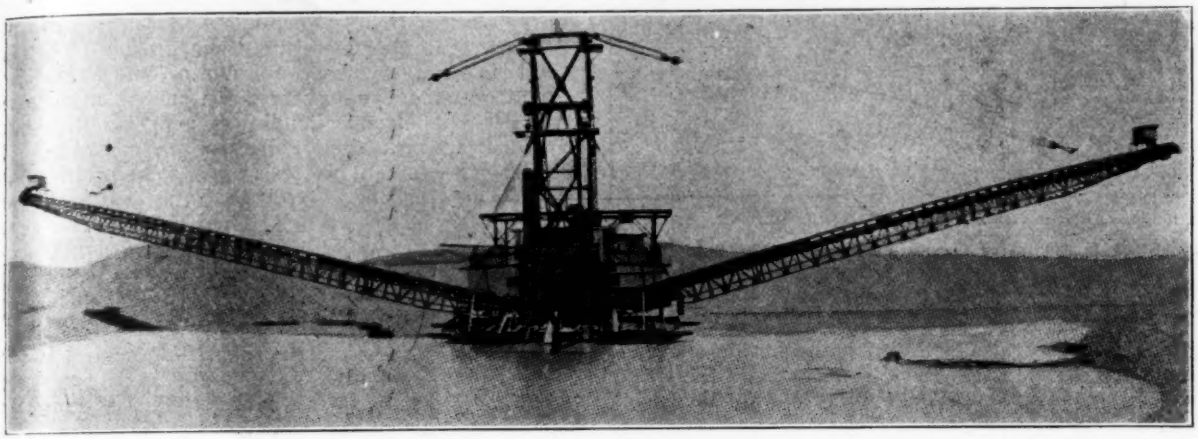


Rear View of Yuba No. 16 Dredge With Double Tailing Stacker. Cable Floats Are Shown on Left Side of Dredge.

Use of Electricity on Gold Dredges

Description of Typical Dredge—Value of Central-Station Service for this Work—Points to Observe in Selection of Apparatus Required—Description of Electrical Equipment Used

In the operation of gold dredges electricity is used almost universally as the motive power. There are a few isolated cases where steam, oil or water power engines are used but these are very rare. Wherever possible, central-station service is used and where this is not available steam-turbine or engine-driven generators are used.

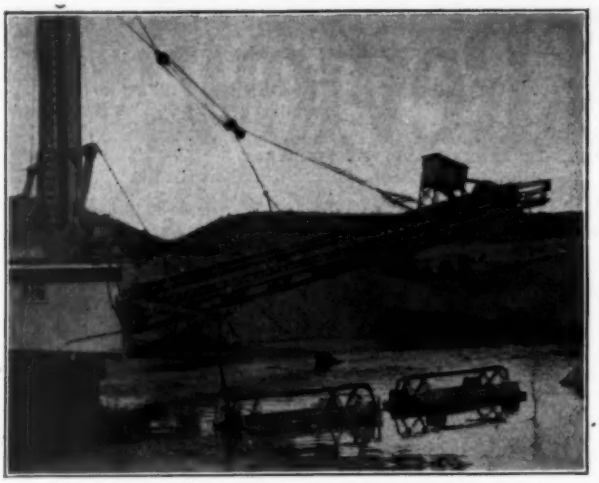
There are several very good reasons for this. As the dredge is meant for use on water it is essential that the space on it be utilized as economically as possible. Electric motors, even when accompanied by transformers or generators, are not only lighter but permit of more even distribution of their weight than does a steam-engine. Furthermore, the dredges are not built for permanent use. They are stationed and usually built in one location and when this ground has been worked out they are abandoned. The cheaper initial cost of the electric motor as well as the ease with which they can be installed or removed is of advantage in this case. For this work, also, electric motors can be operated more economically than any other form of power. There are times when it is necessary to operate all the machinery of the dredge at one time, and although such times are not frequent, power enough for the entire dredge must be available when it is needed.

The advantages possessed by individual motor drives in this respect are very great. The ruggedness and ability to operate under adverse conditions of the motor is another quality which makes them valuable for dredge work. Operations are carried on under all kinds of atmospheric conditions and are subject to severe strains of all kinds. Further advantages possessed by the electric motor are its ease of control, low maintenance cost and the ease with which it can be replaced or repaired.

Although the recovery of gold from sand and gravel is one of the oldest forms of mining, the use of power dredges for this work is of recent origin. The first steam dredge was tried out in New Zealand in 1882 but until 1900 they were not used successfully. From these early dredges capable of handling 50 cu. yd. per hour to the modern dredge which can dig 80 ft. below the water level and handle close to 600 cu. yd. per hour is a step for which the use of electrically-driven apparatus is largely responsible. In the production of gold by this method California leads the world, the production in that state having been $71,000,000 from the beginning of operations until 1915. The total production for the United States for the same period was $81,000,000, Montana, Idaho and Colorado furnishing the bulk of the balance. During 1914 there were about 80 dredges working in the United States alone.

DESCRIPTION OF DREDGE.

The gold dredge in appearance is not unlike the dredges commonly seen in many large rivers except that it is larger. In a gold dredge, however, the sand or gravel brought up by the buckets is carefully washed and sorted and any gold which it contains is extracted, before it is thrown out. The hull, made of either wood or steel, is rectangular, with a hole or well extending from the bow to about the center. Through



Power-Cable Floats for Supporting Cables Leading to Dredge.

this well runs the bucket line for digging and lifting the soil. Mounted on the bow is the bow gantry, which serves to raise or lower the bucket line. At the stern are the stern gantry, the stacker and the spuds. The stern gantry supports the outer end of the stacker and the spuds and serves to raise or lower them. The stacker distributes the worked soil at a considerable distance from the dredge in order that the same ground may not be worked too many times. The spuds act as an anchor and serve to keep the dredge in place while it is in operation. In the interior of the dredge are located the motors, hoppers, screens, sluices, etc.

The electrical equipment on the dredges usually comprises in addition to the interior and flood lighting, six or more motors, having an average connected load of about 1000 hp. These motors vary in size from the large bucket motors to the small pumps. The largest motor now in use on any dredge is rated at 500 hp. but is capable of developing 700 hp. Due to the severe strain to which the bucket motor is subjected when a boulder or hard ground are encountered, this motor has usually been belt-connected, but recent trials with a gear-connected motor using a large friction-disk clutch have been very successful. In this case the clutch was put on the first counter-shaft from the motor.

The pump motors are usually direct-connected to centrifugal pumps. These pumps are used on account of the low head required and the large amount of water to be handled. The stacker, hoists, etc., are usually direct-connected to winches.

Comparisons of the value of the different drives and motors is difficult as the power consumption varies greatly, according to operating conditions. The following data, Table 1 being belt-drive and Table 2 direct-connected, give a fair idea of the power consumption of each, although they will not serve for comparing the qualities of the different drives. The difference in power consumption caused by different operating conditions, however, is shown. In Table 1 it will be seen that the power used by No. 2 dredge was only 0.62 kw. per cu. yd. while that of No. 8 was 2.4 kw. per cu. yd. Table 2 covers a longer period, therefore, the consumption is more uniform. Dredges No. 1 and 2, although identical in size and equipment, show power consumptions of 1.55 kw. per cu. yd. and 1.89 kw. per cu. yd., respectively, indicating that even for longer periods operating conditions are the main factor in power consumption.

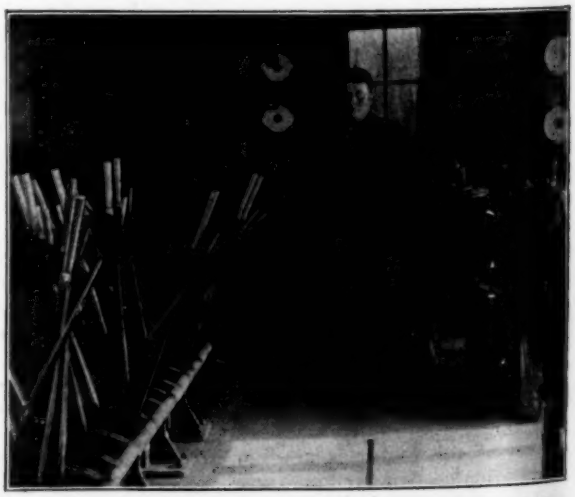
The question of what kind of power to use is as hard to decide as the question of drive. In many cases the question is decided in favor of alternating-current by the use of central-station service. For a number of other reasons also alternating-current is desirable. Of course, in operation the high-voltage direct-current motor, which permits of better control and greater starting torque, especially for use on the digging motor, would be preferable. However, alternating-current motors have been built with speed-torque characteristics which closely resemble those of direct-current machines and their greater ability to stand hard usage with a minimum of care make them very acceptable, even where direct-current motors are available. The same conditions apply to the other large motors on a dredge, but for the constant-speed pumps the induction motor is much to be preferred.

The starting and control apparatus, for the larger motors especially, is varied. The usual grid resistance is largely used, but magnetic control and liquid rheostats are also found occasionally.

Value of Central-Station Service.

As was stated, wherever possible, central-station service is used by dredge companies in preference to manufacturing their own power. This is done not only on account of the lower power costs, but also on account of the lower initial cost and because the use of this service takes much of the weight from the hull. The central-station service is usually transmitted at a high voltage to the transformers located either on the dredge or on the shore as close as possible to the dredge. It is transported aboard the dredge either by armored insulated cables under the water or supported by floats above the water, or by a direct overhead drop from the shore. This latter method is, of course, the cheaper and better but can only be done when the service entrance is on the bow of the dredge. It is very seldom advisable to have the service entrance located at this part of the dredge as the bow moves around continually. Of the other two methods, the one of supporting the cables on floats although cheaper in initial cost and permitting easier moving, necessitates replacing the cable more often, as the insulation deteriorates sooner on account of being wet and dry alternately.

The wiring aboard the dredge is done in strict accordance with the Underwriter's rules, special attention being paid to safety features. In many cases all



Control and Switch Room on Conrey No. 4 Dredge.

Table No. 1.—Power Consumed by Natoma Dredges (Belt-driven) During One Month's Operation.

Item.	Dredge No. 1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Bucket capacity, cubic feet	13.5	8.5	8.5	13.5	9	9	9	15	15	15
Height of bank being dredged:										
Above water, feet	4	3	6	2	12	6	20	10	3	16
Below water, feet	16	23	20	18	44	54	42	53	58	21
Daily operating time, hours	19	20	19	21	21	21	20	19	20.5	19
Gravel dredged, cubic yards	232,014	232,644	124,440	205,274	159,294	150,533	170,690	142,529	238,004	253,376
Power consumed, kilowatts	221,440	143,520	137,600	192,600	238,800	219,600	272,000	346,800	362,400	282,000
Power consumed per cubic yard, kilowatts	0.95	1.10	1.10	0.93	1.49	1.45	1.59	2.4	1.52	1.11

the wiring is done in conduit. Where the transformers are installed on board, a special fireproof house is usually provided for them. Many of the dredges are equipped with a special fire pump. These are, wherever possible, connected to an independent power supply.

Description of Equipment on Yuba 14.

The following is an extract of the description of the electrical equipment on the Yuba No. 14 by Gardner and Shepard from Bulletin 127, Department of the Interior, Bureau of Mines.

The power is furnished by the Pacific Gas & Electric Co. at three-phase, 60-cycle, 4000 volts. The power is brought on board the boat through 750 ft. of No. 0 B. & S., three-conductor cable, insulated for 4500 volts. This cable is brought on board on pontoons and enters a switch house on the upper deck near the stern. In this switch room are located the main line switches and the metering equipment. The meters themselves, however, are on the distribution board

Table No. 2.—Power Consumed by Conrey Dredges (Direct-Gear-Connected) from Time of Starting to July 31, 1915.

Item.	Dredge No. 1.	2.	3	4.
Bucket capacity, cubic feet.	7½	7½	9½	16
Total time operating, hours.	44,950	41,754	50,867	23,520
Average depth, feet	22.1	28.1	40.8	45.3
Cubic yards dredged	7,890,000	6,268,000	8,646,000	10,025,000
Power consumed, kilowatt-hours per yard	1.55	1.89	1.73	1.36
Power cost per cubic yard, cents	1.27	1.55	1.48	1.09

which is located in the winch room. The lighting is supplied by a 15-kw. transformer.

The main drive and winch motors are controlled from a double-circuit control panel located in the winch house. The digging or main drive motor is a 400-hp., 514-r.p.m., 3-phase, 60-cycle, 440-volt, slip-ring, induction motor, with three bearings, pulley and sliding rails, with master controller and contacter panels, and is provided with resistance good for continuous operation at all speeds, from 50% normal to normal. A 35-hp., 600-r.p.m., slip-ring, variable-speed motor, equipped with a resistance for continuous operation from 50% to full speed, operates the winch, raises the spuds and swings the boat.

The stacker and screen motors are controlled from independent panels in the stern of the boat. The screen motor is a 75-hp., 600-r.p.m., slip-ring variable-speed motor and the stacker motor is a 60-hp., 600-r.p.m. motor of the same type. Both motors are equipped with resistances for continuous operation from 50% to full speed.

The panels for the pump motors are placed on the lower deck, the starting compensators for the pump motors being mounted alongside the panels. All the pump motors are squirrel-cage motors, the high-pressure pump having a 150-hp., 600-r.p.m. motor and the low-pressure pump having a 75-hp., 600-r.p.m. motor. The 6-in., two-stage pump has a 50-hp., 1200-r.p.m. motor and the vertical pump has a 10-hp. vertical motor. With the exception of the 10-hp., all these motors are direct-connected.

PLANS COMPLETED FOR THE ELECTRIFICATION OF SWISS RAILWAYS.

Substitution of Hydroelectric Power for Coal Results from Difficulty Encountered in Obtaining the Latter.

The idea of using the immense hydroelectric power resources of Switzerland as a substitute for coal in the operation of the railways of that country has been under consideration for some time. Although the nature of the country is particularly suitable for this transfer, the amount of money which must necessarily be involved has thus far prevented the adoption of this form of power. The difficulty experienced during the war in obtaining coal has caused the authorities to draw up tentative plans for this work which will probably assume definite proportions and begin very shortly now that the war is over. A recent United States consular report contained an outline of this plan which calls for a gross expenditure of $150,000,000 and embraces a period of 30 years.

The momentary maximum demand for the operation of these railways is estimated at 600,000 hp. with an average load of 200,000 hp. Permission has already been obtained for the use of various water-power sites from the government which will aggregate nearly 150,000 hp., or three-quarters of the estimated load. The sites thus far secured are: The power of the Reuss from Andermath to Amsteg; the Tessin, from Airolo to Lavorgo; the Rhone, from Fiesch to Moerel; the Binna, the Barberine, the Eau Noire and the Trient. The remainder of the necessary power will be partly purchased from existing plants and partly developed from prospective plants, the location of which will be decided upon later.

No provision has been made for changing the present steam locomotives as it is the intention to replace these with electric locomotives as fast as they wear out. For this reason everything possible will be done to avoid the purchase of any new steam locomotives which should lend considerable impetus to the work of electrification.

AUXILIARY ELECTRIC HEATING IN MILD WEATHER.

The use of electric heating devices as auxiliaries to other systems to warm up an otherwise cold room or during chilly periods in the spring and autumn when the furnace is hardly needed will prove in very many cases a great convenience; and, provided that the periods of use be short, e.g., for an hour or two in the morning or evening, it will be almost as economical to use electric energy in this manner as to light a fire in the furnace, and very much less trouble.

Linking Science and Art in Lighting

Third of Six Articles Pointing Out the Wide Range of Opportunities in Artistic Lighting, a Field that Has Been Sadly Neglected and Is Just Beginning to Be Developed*

By M. LUCKIESH

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PART III.—LIGHTING FIXTURES.

It is not the purpose of this article to discuss either the scientific or artistic design of fixtures separately, but, as in the other articles, it is the aim to treat the correlation of science and art. This is the greatest need in lighting practice today, for we cannot criticize either the engineer or the artist in his own field but we may justly deplore the fact that they do not generally correlate their abilities. The engineer has contributed extensively to the development of lighting and the artist has designed fixtures of the highest merit esthetically, but it is not an insurmountable task to introduce both science and art in fixtures and other aspects of lighting as has been shown by certain fixture manufacturers. As we look over the successful fixtures of today which are really contributing toward progress in lighting, we note that they are the products of manufacturers who have realized that scientific knowledge must be interwoven with artistic skill and who have found a way to bring these two factors together in their organizations.

Of course, there are many fixtures used in esthetical lighting purely for their beauty as ornaments. This will perhaps ever be the case, for what is more beautiful than an artistic lighting fixture. But inasmuch as the design of fixtures for our beautiful interiors is in the hands of the artist, many possibilities in lighting remain unrealized because the artist is unfamiilar with the science of light control. If fixtures are required for the purpose of obtaining a certain lighting effect, the illuminating engineer should possess the ability to design the purely utilitarian mechanism and the artist should be able to clothe this mechanism with a beautiful exterior. It is often remarked that this correlation is impossible, but common sense and many fixtures in use today convince us that it is not impossible.

It is not the intention to discuss either the scientific or artistic aspects of fixture design, for such a discussion would be out of place in this article. Certainly it will be admitted that splendid ability has been shown along these individual lines. However, it must be realized that the greatest class of consumers of esthetical lighting must depend upon the fixture dealer and, therefore, the fixtures which are available and the manner in which they are displayed and sold is of great interest in a consideration of the development of this field of lighting. Competent authorities would perhaps agree that many fixtures on the market have no esthetical merit. But inasmuch as this is a matter of taste, the consumer may choose what he likes. However, even the taste of our people as a whole may be guided somewhat toward higher levels. The worst feature of the fixture situation is that most fixtures do not aim to do anything definitely, that is, to produce a certain effect. Owing to the high brightness of modern light-sources compared with the older types, it is necessary to diffuse the light or to shade the lamp. Many fixtures do this to a fairly satisfactory degree.

Fixture Dealer Must Sell Lighting and Not Merely Fixtures.

But the greatest outstanding defect in the fixture business is found in the manner of display and sale. If we are to awaken the interest of the consumer and thus further develop this field of lighting, he must be convinced that the virtue of lighting lies in its effects. In other words, he must be sold lighting instead of mere fixtures, and he must have convenience in control and plenty of circuits and outlets in order that the attractive feature of variety in effects is readily available.

Fixture dealers with a few exceptions are at present selling fixtures, not lighting or lighting service. If this statement be doubted it may be verified by visiting the average fixture store and viewing the maze of lighting units suspended from the ceiling, mounted on the walls, and grouped upon the floor. Is it possible under such conditions to display the lighting effect from a fixture? Let us go further and discuss fixtures for our home with the average fixture salesman. Does he discuss lighting effects or fixtures? In the first place, it is unusual to find a fixture salesman who realizes that the consumer desires, perhaps only vaguely, to purchase lighting. Of course, he desires beautiful fixtures which harmonize in style with the interiors which he has in mind. But the exterior dress of a fixture, such as proportion, finish and grace of lines, should be a final detail. Does the average salesman inquire as to the type of room, its decorative scheme, its spirit or mood, or the effects which the customer may desire for various occasions? Is he a student of the psychology of lighting in the living and dining rooms? Without such knowledge he does not sell lighting; instead, the customer purchases only fixtures.

It would be impracticable to display the lighting effects obtainable from every fixture which the dealer may have in stock, but it would not be difficult to classify lighting effects into a dozen classes. Combinations of these could be demonstrated in the same room or alcove and thus introduce the customer to the pleasing element of variety in a given room. Let us outline a possible procedure for carrying out this lighting propaganda which would aim to do several things, some of which are: (1) to demonstrate to the customer that lighting is a powerful agency in beautifying a home and in making it more enjoyable; (2) to display lighting effects obtainable from the various classes of fixtures, which, by the way, are assumed to be classified according to the foregoing suggestion;

*The first and second of these articles appeared in the Electrical Review of Oct. 5 and Nov. 2, 1918.

(3) to make certain that the customer has finally purchased lighting for his home consistent with the moods of its rooms, and has not ordered merely a set of pretty fixtures.

Suggestions for the Fixture Dealer in Demonstrating Lighting Effects.

In order to carry this out the following ideas are suggested. These may be too elaborate for all dealers, but some portions or modifications of them may be possible. A small room may be filled with a number of lighting schemes for the purpose of convincing the customer that lighting has great possibilities and is worthy of a greater expenditure of money than is usually allowed for this item, especially in the home. In this demonstrating room a cove in which lamps are concealed may be incorporated without being conspicuous. Brackets may be mounted on the walls. Portable lamps may be conveniently and artistically located as a part of the furnishing of the room. A special fixture may be hung from the center of the ceiling which could be provided with sufficient circuits to illustrate direct, semi-indirect and indirect lighting effects and combinations of these. In such a room various minor utilitarian and artistic uses of light could be demonstrated without having the room overloaded with fixtures.

Without depending very much upon the imagination of the customer, nearly every feature of lighting in a home could be demonstrated in a room of this character. It would be well to finish the walls and ceiling with fairly neutral grays not differing very much in shade. Such a room is very sensitive to lighting effects. If the demonstrator is properly versed in lighting and its possibilities, the customer should profit considerably; his eyes would be opened to the importance of lighting, and he would doubtless be in a frame of mind to appropriate adequately for the purchase of the lighting for his home.

Following this demonstration he may be shown the effects obtainable with the various general classes of fixtures and the desirability of several circuits, controls and outlets. These could be demonstrated in small alcoves with suitably finished walls and ceiling. By placing fixtures in these general classes and actually demonstrating the lighting effect it might be possible for the customer to make his entire choice of fixtures, pertaining to artistic features, from drawings, photographs or catalogs. Samples of various finishes may be displayed. The stereoscope has been used successfully in selling and after such a procedure as already outlined it might find a wider use in the sale of lighting fixtures.

Actual Fixtures May Be Sold Largely From Catalogs.

If the sales could be made largely from illustrations preceded by the general demonstrations it would be possible for dealers to reduce their showroom stock very materially. This reduction would be a saving that might go far toward paying for the installation and maintenance of demonstrations as outlined in the foregoing. This procedure is a radical departure from present practice (although a few dealers are tending toward this) but revolutionary changes must be made if a complete development in this field is to be realized.

As already stated, excellent fixtures as viewed purely esthetically may be obtained to suit any requirement of taste, although there are vast numbers of fixtures on display which have little or no artistic merit. Similarly, excellent accessories, as viewed purely scientifically or from the viewpoint of light-control, have been designed and are to be found in practice. But to make fixtures which produce definite previsualized effects and which are sufficiently supplied with circuits to make it possible for the householder to escape from the usual monotony of lighting, appears to be a rarer accomplishment or intent. Some fixtures on the market and others in practice, which have been especially designed, attest to the possibility of such developments. Careful observation will reveal these among the mass of indifferent fixtures.

A Few Fixtures in Which Variety in Lighting Effects Is Obtained.

On visiting a display room let us examine the decorative floor lamps. They vary greatly in outward appearance and as we light one after another we find that they are decorative housings for lamps. No variety in lighting effects are obtainable, except in some cases a variation in intensity. Most of them direct the light predominantly downward. But finally we reach a unit which is just as artistic as the others in appearance but it is evident that its exterior is concealing a mechanism thoughtfully designed to extract from lighting some of its charm. One pull-chain switch floods the room with indirect light; another provides a direct component. The combination of these produces a third effect. On experimenting with this lamp we conclude that scientific design does not handicap the artist in producing a beautiful lamp.

Next our attention is attracted to a flower box on the wall. It is a beautiful ornament, but it possesses a switch. We press the switch and a flood of light greets us. On looking into the box we find that it contains a reflector of the highest scientific merit which directs the dominant light away from the wall toward the center of the ceiling. Again science and art are found associated in harmony.

We next investigate dining-room fixtures intended to be hung above the table. Many of them are beautiful, but only one effect is obtainable from each and on close observation we conclude that the effects are merely indifferent and bear no particular relation to the lighting problem confronting us. Then we find a unit that is just as artistic as the others but it appears to have concealed beneath its artistic dress certain reflectors which direct the dominant light downward to the table but apparently the light-sources are well shielded from the eyes of the diners.* Another set of reflectors directs some light upward and here we are again pleased by the charming variety of effects.

And so we proceed in our quest, but the results are merely repetitions of those already described. We find many artistic fixtures whose lighting effects are more or less indifferent; occasionally we discover a fixture in which science and art are harmoniously combined and whose switches we take delight in operating because there is a variety in the effects obtained. We imagine such units in our home and visualize the effects we would use for various occasions and how we would suit the lighting to our mood. However, we would also realize that we made these discoveries more or less independent of the salesman. In fact, we wonder why he has not discussed lighting, for, in reality, that is what we have been seeking. Fixtures are sometimes of greater importance than lighting effects but not usually. Fixtures should be artistic but they are merely a means to an end—and that end is lighting.

(To be continued.)

*"The Lighting Art," by M. Luckiesh, p. 141; McGraw-Hill Book Company, New York, N. Y.

Economic Operation of Steam Turbo-electric Stations—I.

Bureau of Mines Technical Paper Discussing Fuel Economy Factors, Load Distribution Between Units, Boiler-Room and Auxiliaries Operation—First Installment

By T. C. HIRSHFELD and C. L. KARR

Under war-time conditions, with the demand for fuel taxing the productive capacity of the mines and exceeding the facilities for quick distribution, there is especial need of giving the utmost attention to all methods whereby loss or waste of fuel may be minimized or prevented and all heating or power plants worked at highest efficiency.

The large central power or heating plants, such as are now in service in many cities, offer special opportunities for practical application of fuel-saving methods, because the increase of economy can be had by making changes that are practicable within a reasonable time and do not call for the employment of higher engineering supervision than is already available; whereas the losses at small plants, although vastly greater in the aggregate, require the education, training and supervision of boiler-room employes and, at many plants, the replacement or extensive modification of present equipment.

In a series of publications the Bureau of Mines has discussed the various problems involved in obtaining higher furnace efficiency at the smaller heating and power plants, especially those with hand-fired boilers. The present paper discusses the economies to be effected in the use of fuel through changes in operating methods at large power plants having turbogenerators.

Factors Determining Fuel Economy.

The maximum economy attainable in the use of fuel in any given turbogenerator station is determined by the characteristics of the apparatus installed and by the way in which that apparatus is assembled and connected—that is, by the design of the station.

The actual working economy is determined by the fuel used, by the temperature of available circulating water, by the character of the load to be carried, and by the operating methods adopted.

Under normal conditions that fuel should be used which gives the minimum figure for the sum of the following items:

1. Cost of coal delivered to storage.
2. Cost of preparing coal for use, as by crushing or screening.
3. Cost of transferring coal from storage to bunkers.
4. Cost of transferring coal from bunkers to furnaces.
5. Cost of removing refuse.
6. Cost of rehandling and other labor caused by spontaneous combustion.
7. Maintenance of coal-handling, preparing and burning equipment.
8. Capital charges on equipment required to generate the required amount of steam.

In the present state of knowledge there is no method of determining, by reasoning or by analysis, the coal that will give this minimum. In general, each variety available in a given district must be given a trial thorough enough to enable the operating engineer to obtain actual cost figures. As a rule, a medium-price coal gives the best results. Occasionally the coal that is most expensive on a ton basis really gives the minimum total of all costs concerned.

The temperature of the circulating water is, in general, entirely dependent on the characteristics of the supply and on the effect of seasonal changes and is thus beyond the control of the operating engineer.

The character of the load to be carried is also, in general, beyond the control of the operating engineer. He must accept that load which the industry or community that he serves gives him at any particular instant. His job is to carry that load throughout all of its variations in such a manner as to attain as nearly as he can the minimum production cost possible with the equipment available, but he must always carry this load in such a way as to obtain the degree of continuity of service demanded or desired.

Operating methods of this sort require the closest study of all of the items entering into the cost of net or available power—that is, power leaving the plant and available for external use. Labor, supplies and maintenance in turbine room and boiler room are just as important as is fuel cost. No detailed operating method can be laid down as applicable to each plant, because apparently insignificant local peculiarities may in reality greatly modify the most economic operating method.

This paper is intended to consider only the effect of operating methods upon the fuel consumption, and the parts following are devoted entirely to that phase of the problem. However, in reading them, one must bear in mind constantly the more general considerations already enumerated. Methods giving the smallest fuel charges are not necessarily the most economical methods: true economy comes only from a realization of the complete problem and the use of an operating method which represents the best possible compromise between the many conflicting interests outlined above.

In a single plant with a given load curve, the fuel economy is dependent upon three distinctly different things. These are:

1. The method used in distributing the load between the main units available;
2. The methods used in the boiler room for producing the steam required; and
3. The method used for obtaining auxiliary power or house service.

These three branches of the problem will be considered separately in what follows.

Distribution of Load Between Main Units.

Most of the steam-driven turbogenerators built in

this country have steam characteristics of the general type shown in Fig. 1. The steam required, per kilowatt-hour delivered, decreases with increasing load until some best point is reached, after which increasing load causes an increase in the steam used per unit of power delivered. Or, the total steam consumption increases approximately according to a straight-line law until at some point the increase occurs at a more rapid rate, causing the graph of total steam consumption to curve upward, as shown in Fig. 1. Some turbines built recently possess steam characteristics giving more complicated graphs when plotted, but attention will be confined to the type shown in the figure because of the greater simplicity and because

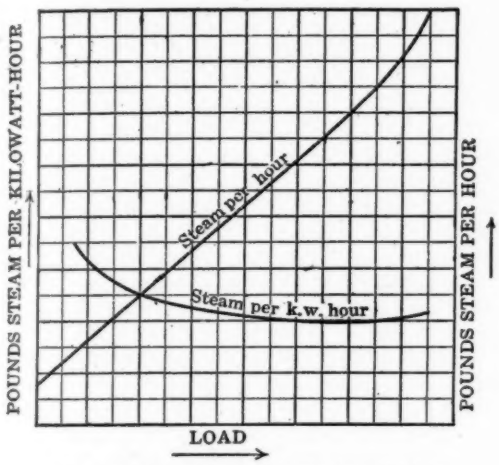


Fig. 1.—Steam Curves for Turbogenerator.

the same sort of reasoning can be used to evolve proper operating methods for units with more complicated characteristics.

Water-Rate Curves.—It is well known that steam pressure, superheat and vacuum or back pressure all have marked effects upon the steam consumption, or water rate, of steam turbines. The water rate is decreased by increased pressure, by increased superheat, and by improved vacuum. Pressure and superheat may be regarded as fixed in any given plant, but the vacuum attained is of necessity quite variable, when considered over long periods of time.

It is therefore possible to obtain a whole family of water-rate curves for a given machine in a given station, each member of the family corresponding to a different vacuum or back pressure.

Moreover, the water rate of a given unit under given conditions of pressure, superheat and vacuum also varies from time to time. The variations are apparently due to such things as deposits on blading, wear of blading, variation of clearances, settlement in bearings and other uncontrollable factors. The exact shape and position of the family of curves mentioned is therefore constantly shifting.

Any logical method of operating turbogenerators in such a way as to cause them to make minimum steam demands for given loads must obviously depend upon a fairly complete knowledge of the shape and location of their water-rate curves. These can be obtained only by water-rate tests, and it therefore follows that, for best operation, routine testing of units at definite intervals is necessary.

Experience has shown that it is necessary to test each machine through its entire range of load once in every eight weeks at stations operating continuously if a fairly exact knowledge of conditions is to be maintained. Tests made at about five or six equally spaced loadings generally suffice to determine the curves with the required degree of accuracy.

Such a suggestion is apt to be discarded by many operating engineers on the grounds of difficulty or expense. As a matter of fact, neither of the arguments can be maintained in the face of figures that are easily obtainable. The cost of the testing equipment and the testing are more than paid by the savings effected through operating on the basis of known water rates.

Need of Water-Rate Tests.—Some of the recently built stations using surface condensers have incorporated the weighing tanks, scales and piping necessary to permit the crew to make weighed water-rate tests at a minute's notice. The work consists merely in opening and closing a few valves and taking the necessary readings. Tests of this sort are very accurate if made at fairly steady loads over long enough periods of time, and if condenser leakage and steam leakage are guarded against. Condenser leakage is detected easily by well-known chemical methods if the circulating water is salt, and is just as easily and more expeditiously found if the circulating water is fresh by determining the electrical conductivity of the condensate.

At plants having surface condensers that were constructed without provision for tests of water rate by weighing, it is often possible to install the necessary equipment at moderate expense. Particularly, when all hot-well pumps discharge into one header, it is usually a comparatively cheap and simple matter to install a parallel header with valves so arranged that any hot-well pump can discharge into weighing tanks while the discharge of the other pumps travels the customary route.

In surface condenser plants in which weighing apparatus cannot be installed, or in which water-jet air pumps are used, and in plants fitted with jet condensers, recourse must be had to steam meters of some sort. The results obtained in this way are not as accurate or trustworthy as those obtained by weighing but they can be made accurate enough to yield results that will serve as a basis for operating methods.

It is therefore justifiable to assume that operating engineers who care to obtain the best possible results can make provision for such periodic testing as is necessary to give them a fairly complete knowledge of the water-rate curves of the units under their charge. If this is so, it is certainly rational to base further treatment of operating methods on the assumption that the necessary water rates are known.

The characteristic shape of the water-rate curve, with its well-defined minimum, shows plainly that a unit consumes the minimum quantity of steam per kilowatt-hour generated when running at the load giving that minimum. Moreover, the curve is generally of such a shape that the water rate does not vary greatly for considerable variations of load either side of that giving the minimum value. The operating method outlined below is based on these facts.

Combining Station Units for Minimum Steam Demand.—It is obvious that there must be some combination of the several machines generally available that will cause minimum steam demand for any given load. It is often casually assumed that this distribution is that which causes all the machines in operation to carry loads as nearly as possible approximating those that correspond with the minimum points of their respective load curves. This assumption is only

correct when all machines have curves of the same shape and height—that is, when all have practically the same water-rate curve.

For such conditions, the minimum steam demand is obtained by operating such a number of machines as will be required to carry the existing load when each of those operating is carrying a load near its best point. Thus assume a station containing two 10,000-kw. units and one 15,000-kw. unit, all having exactly the same water-rate curve. Assume that for the conditions existing the two smaller machines have their best point at 7000 kw. and that the larger has its best point at 11,000 kw.

If a load of 10,000 kw. is to be carried, two of the small machines might be operated at 5000-kw. loads; or the large machines might be operated alone; or the larger machine and one of the smaller might be operated in parallel with any desired distribution of load between them. With water-rate curves of usual shape it would be found that the single large unit operating at 10,000 kw. would create a smaller steam demand than would the two smaller machines operating at 5000 kw. each.

Also, either of these combinations should make smaller steam demands than any possible combination of one large and one small machine under the assumed conditions. The choice would then probably be between the first two possibilities.

If continuity of service was not of great importance the operation of the one large unit would be the correct solution. With such an arrangement, however, an accident that disabled the one unit operating would completely interrupt the service. Therefore, when the operator is limited to obtaining the minimum steam consumption consistent with reasonably certain continuity of service he must choose to operate the two smaller machines despite the slightly greater steam consumption. An accident to one would probably cause no interruption because the other could pick up all of the load dropped by the disabled machine and still not exceed its own load-carrying ability.

If a load of 15,000 kw. is to be carried it is perfectly obvious that the minimum steam demand will result from the use of the two smaller machines, each carrying 7500 kw. This arrangement is not consistent with reasonable assurance of continuity of service because the surplus capacity of one machine is not enough to absorb the load carried by the other in case of failure. As a matter of fact, continuity of service at this load could not be assured by any combination of two machines, and if assured continuity were considered of great importance three machines would have to share the load. The best distribution under such condition could be determined easily by assuming different values for the load carried by the largest machine, dividing the remainders equally between the other two and then determining the steam demand with each combination.

Under the assumed conditions of like water-rate curves for all units the solution of the problem of obtaining assured continuity of service and low steam demand becomes simpler as the number of units available is increased and as the capacities of the units approach one common value.

In practice it never happens that all units available have the same characteristic curves. Even if they are all of one design and of the same size, it will be found that their water-rate curves differ materially. The problem actually met is therefore more complicated than that outlined above, but the principles involved in its solution are about the same.

Method of Determining Load Distribution.—It is possible to determine mathematically the distribution of load between units so as to yield the minimum water rate for any given station load, but this method has not yet been reduced to a form easily understood and applied. An alternative cut and try method is therefore given here. It is less exact and is time consuming, but it is capable of giving excellent results if applied carefully.

For the purpose of illustration, consider a station containing six units designated as A, B, C, D, E and F, with water-rate curves for given conditions approximately as shown in Fig. 2. Three of these machines might be called 10,000-kw. units, two 14,000-kw. units, and the largest a 20,000-kw. unit, but it is important to note that what they are rated or called has nothing to do with the problem in hand. The curves show that each machine is capable of carrying a load up to some particular value and that it uses a certain different number of pounds of steam per kilowatt-hour at each different load up to that maximum value.

For convenience in reading, the horizontal lines *a*, *b*, *c*, etc., have been drawn. The line *a* is tangent to the lowest point of curve E, that showing the water rate of the unit second in economy. The line *b* has been drawn tangent to the lowest point of curve C, that of the unit ranking next, and so on.

It is not probable that a station of the size indicated would carry loads as small as 2000 kw. at any time, but the individual curves have been plotted down to that value and the analysis will be started at that point for the sake of completeness. Inspection of the curves shows that machine C has the lowest water rate at 2000 kw. and therefore is the machine which would be used for carrying a load of that magnitude.

If a straightedge be placed across the figure horizontally at a height representing 14.5 lb. of steam per hour and be gradually moved downward while kept parallel to the horizontal axis it will cut all curves at equal water rates. Comparison of loads at different equal water rates on the several curves shows that machine C can carry any load from 2000 kw. up to about 9000 kw. more economically than any other machine.

Beyond this point machine E should be given the load. It can carry loads from 9000 to 12,500 kw. more economically than any other machine.

Beyond that point the load should be given to F, and it is obvious from the figure that this machine is fitted to carry from 12,500 up to 18,000 kw. more economically than any other.

Next, it is necessary to decide whether a load above 18,000 kw. can be carried more economically on F alone or on some combination of machines.

Actual numerical trial will show that the greatest economy will be obtained by carrying load on F up to some point above 18,000, but that somewhere between 18,000 and 19,000 kw. the load should be shifted to C and E, giving about 8000 to C and about 11,000 to E. Such a combination would yield a water rate of about 11.8 at 19,000, as against about 11.85 for the same load on F alone. The point of change may be assumed at about 18,500 kw.

It is next necessary to discover how far to carry the load on the combination C and E. Inspection of the curves indicates that 8000 kw. on C and 12,600 on E will give a load of 20,600 kw. with a water rate corresponding to the height of the line *b*. Inspection also shows that 8800 on E and 12,400 on F will give a total load of 21,200 with the same water rate.

Obviously the load would be carried on C and E

from a total of 18,500 to about 21,000 after which it would be carried on E and F to a total of 12,600 + 19,600 = 33,200 kw. The best distribution between E and F at each different load between 21,000 and 33,200 must be found by cutting and trying, but it is obvious from the curves that at loads between 11,000 + 14,000 = 25,000 and 11,000 + 18,000 = 29,000 the load will be held constant at 11,000 on E and the remainder will be taken on F.

Beyond a load of 33,2000 kw. the possibility of using machine C must be considered because the water rate when carrying that load on E and F in parallel is the same as the best water rate on C. As a matter of fact, the load would have to be increased beyond 33,200 before C is utilized because this unit cannot be utilized with the water rate in question at a load less or greater than about 8000 kw.

This sort of analysis can be carried through in the way outlined until a loading schedule has been developed for all loads between 2000 kw. and the maximum of which the station is capable. It is laborious and slightly confusing when more than three machines are being considered, but the fuel savings that can be effected by operating on schedules developed in this way are so great as to amply justify much more labor than can possibly be involved in utilizing this method.

The water rates for different station loads that result in the case assumed above have been plotted in Fig. 3 up to the point to which the analysis was carried. It should be noted that the curve gives only the water rates resulting from the operation of the main units and that the real station water rates will be further modified by steam used for heating, warming and starting units, and for operating auxiliaries.

It is also interesting to note that the curve is far from smooth but that it shows a gradual downward trend to a load of 16,000 kw. Beyond that point it must show a gradual rise because of the necessity of utilizing machines at less economical points or less economical machines in order to obtain the greater capacity.

In the analysis as carried out attention was given to one point only, namely, that of obtaining minimum water rates at each load. In practice other considerations must be borne in mind. Thus, operating requirements do not permit the frequent starting and stopping of machines to meet a violently swinging load, nor would such frequent starting and stopping give the results desired because of the necessary incidental waste of heat.

Again, in the analysis, one machine was assumed to operate alone at the smaller loads and to be used if necessary well up toward its maximum capacity. It is possible that some stations might be willing to operate in this way, but if assured continuity of service was desired such operation would not be permissible.

Further, the arrangement of auxiliaries may often be such as to change the conditions decidedly. That arrangement giving the greatest economy, in so far as the main units are concerned, may be far from the best when the thermal cost of auxiliary power is taken into account.

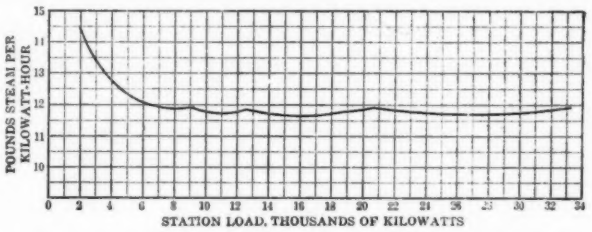


Fig. 3.—Water-rate Curve for Different Station Loads.

Such consideration as well as others of a more or less local nature must always be given full weight. It is generally most convenient to prepare an operating schedule as suggested above and then to modify this, at various points, as necessary to meet other conditions.

It is also essential to bear in mind the fact that in normal cases schedules of this sort are good for about two months only. After that they must be revised, on the basis of experimentally determined curves, to meet the new individual water rates produced by changes in the temperature of the circulating water and by changes in the conditions of the turbines themselves.

The most advantageous distribution of load between stations can be determined in the same way as has been suggested for the distribution of load between the machines of one station. When two or more stations are contiguous or are so operated that they may be treated like parts of the same station, all of the units may be considered as separate entities and the analysis performed just as was done above.

When, however, the stations are operated independently and simply share the load as dictated by a system operator or other corresponding individual it is more convenient to proceed in a different way. The water-rate curve for each station as a whole is drawn in about the same way as shown in Fig. 3, and

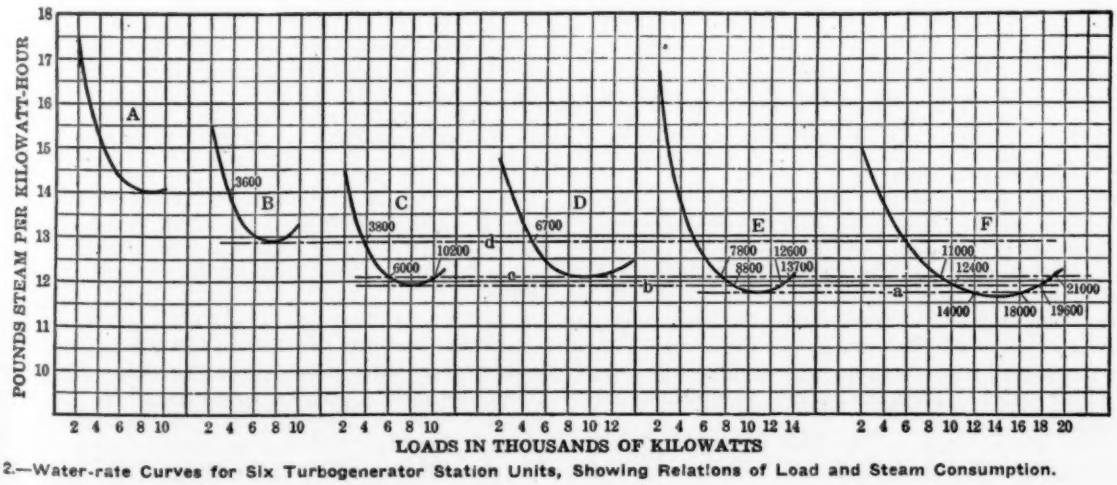


Fig. 2.—Water-rate Curves for Six Turbogenerator Station Units, Showing Relations of Load and Steam Consumption.

these total curves are then handled as were the curves of individual machines in the preceding analysis. This method does not give the lowest water rate theoretically obtainable with perfect freedom in making all desirable combinations of all of the individual machines in all of the stations, but in practical operation it often yields more satisfactory results.

The same sort of analysis is obviously applicable to the case of transfer of load between independent companies with connected networks. Here the problem is still further complicated, in general, by the difficulty incident to obtaining complete information with regard to the characteristics of both stations and the further difficulties experienced in obtaining the sort of co-operation between independent organizations which is necessary to utilize to the full the results of such analyses.

Moreover, the electrical characteristics of the transmission network must be taken into account when distributing load between two or more power plants or systems. Losses of various sorts in the network often make it necessary to apportion loadings differently than would result from a consideration of the thermal characteristics of the several plants concerned.

[The second and final installment of this article will appear in the next issue.]

MINING COMPANY BUILDS NEW HYDRO-ELECTRIC PLANT.

Cleveland-Cliffs Iron Co. Completes Electrification of Its Michigan Mines.

By W. P. Potter.

The work on the Cleveland-Cliffs Iron Co.'s Dead river power project is rapidly nearing completion. It will be the second largest hydroelectric plant in the Upper Peninsula when finished, and will give the company 5000 additional horsepower for use at its various mines. Work on this plant has been in progress for a little more than one year. It is expected to generate its first electricity soon after the first of the coming year.

The completion of this plant marks the fourth and final step in the electrification of this company's lines. The other plants are the Au Train, the Carp and the Hoist, all Dead river projects, which now generate approximately 3800 continuous horsepower, as follows: Carp, 2500; Au Train, 500; Hoist, 800. The 8800 hp. which will be made available to the company with the latest plant in operation is expected to be enough to carry the load of all its mines. In addition, there is a 400-hp. plant at the Republic mine, purchased by the company a few years ago.

The largest plant in the Upper Peninsula is located four miles north of Iron Mountain, at Twin Falls. It generates 7000 hp., which is 2000 hp. more than the Dead river plant is expected to deliver.

The Dead river plant is located seven miles west of Marquette, Mich. The construction of the dam was begun in August, 1917, by the Foundation Co. of New York. It is seven miles from the mouth of the Dead river, on Lake Superior. At the point of its location the granite rock cuts across the river, squeezing it into a 30-ft. channel, at the head of a brisk rapids. As the site offers no opportunity for storing water, the plant is designed to take the natural river flowage.

The concrete mass of the dam is anchored to the solid granite. The dam itself is of the gravity type, 400 ft. long and 50 ft. high. It contains nearly 16,000 cu. yd. of concrete. All the necessary sand, gravel and rock were near, and the contractor took advantage of an old railroad grade to lay a track to the site of the dam, which was a big saving in road building and teaming over a rough country road. In order to complete the project as soon as possible, the men worked from 13 to 18 hours each day.

Description of Power House.

The power house, nearly complete, is located about three miles from the dam. It is 45 by 90 ft., built of solid brick, trimmed with limestone and ornamental brick. The interior is of glazed tile. The water is conducted to the generators through a 7-ft. penstock which lies largely in a rock trench. The first 10,000 ft. of the penstock is of woodstave pipe; the remaining 3600 ft. is steel pressure pipe. The plant is equipped with two General Electric 5000-kv-a. units and two 6500-hp. water wheels.

O. D. McClure had entire charge of the work.

DIFFERENT WAYS IN WHICH JOBBERS BENEFIT DEALERS.

Lower Shipping Costs and Better Deliveries Among Advantages Offered.

The position of the jobber and his value to the electrical industry is particularly well brought out in a recent bulletin of the Mohawk Electrical Supply Co., 325 Warren street, Syracuse, N. Y. The jobber's service, as it is explained, is especially valuable now, if the congested condition of the railroads, the confusion in many manufacturing plants due to the change from war work and the necessity for prompt delivery are to be considered.

The average dealer seldom purchases enough from any individual manufacturer to receive any of the benefits which are to be derived from bulk shipments. By concentrating his purchasing to one or two jobbing-houses, however, he is able to have a number of lines combined and delivered in carload lots and also effect a shorter haul. In this way shipping costs are considerably reduced and the railroads are relieved of much of their burden.

Then, too, many manufacturers are now loaded with orders which have accumulated during the war period, and the confusion resulting from the efforts to fill these orders, and at the same time effect the change from war activities, very often results in tedious delays to the purchaser. The jobber having much of this stock on hand, and knowing much better, on account of being located nearer to the purchaser than the manufacturer, the easiest and quickest means of delivery, is nearly always able to ship immediately.

In the December issue of this bulletin, which is called the Mohawk News Service, a number of appliances which it considers the quick-selling lines are listed. These include the flatrion, the percolator, the upright toaster, grill, chafing-dish, waffle iron, heat pad, radiator, curling iron, immersion heater and flashlight.

A flat increase of 15% in electric and steam heating rates at Aurora has been asked in schedules filed with the public utilities commission by the Western United Gas & Electric Co. Similar advances are sought by the company in electric rates at North Aurora, Montgomery and Oswego.

Editorial Comment

Central-Station Problems of the Hour

ADJUSTMENT of our financial, industrial, domestic and social affairs is taking place in a way that bespeaks our strength and belies our relative unpreparedness for the coming of peace. As previously pointed out in the November 23 issue of the ELECTRICAL REVIEW by Mr. Kentish-Rankin, the sudden cessation of war industries has not and holds no prospect of resulting in marked sustained loss of central-station load or availability of large amounts of surplus power, except in somewhat isolated cases.

As war industries decline, the industries of peace get into the stride, and loads that have had to wait can now be taken on to counteract and in many cases more than compensate for those lost. The decrease in load during the interim, and the lull in the strenuous efforts of the past year, a breathing spell as it were, gives central-station companies opportunity to put to the test some of their theories developed and experiences gained during the war, and prosecute many of the extensions and improvements of their properties so long delayed and so often urgently needed. Many companies will delay their construction in the hope that the cost of labor and materials will go down, a practice that may tend to cause a lowering of prices until accumulated delayed orders and the sudden demands for men and materials create keen competition that will react in raising the price of these commodities.

However, the problems facing the central-station companies are all of a kind and embrace such widely diversified matters as finance, generation and distribution, rates, load and economic, engineering and public policies. And it might be well to point out a few salient facts that may be borne in mind in planning for the future out of the knowledge of the past.

Higher load-factors will be sought by practically every central-station company. These higher load-factors will come about by the connection of those loads that have been steadily making headway of recent years, such as industrial heating, domestic heating and cooking appliances, electrometallurgical and electrochemical processes. The industrial and domestic heating devices, if pushed as they deserve to be pushed, could radically alter the load density of many a distributing circuit and make necessary the adoption of larger underground cable ducts now in readiness for the future. The reliability of apparatus, the sectionalization of trouble and economy of investment have proved to many companies that the maximum capacity of their distributing circuits is needlessly low. The coming of increasing numbers of current-consuming devices, thereby increasing the load density, suggests the wisdom of increasing circuit rating and the rating of regulators controlling them. There is called to mind an instance where within five years one central station changed the maximum capacity of its feeder induction regulators three times, and then found the size of underground ducts imposed the limitation. Future construction, for those building for the near future, should not result in such handicaps as this. A number of networks are already preparing to change from three-wire to four-wire three-phase as a palliative measure.

Power-factor and its correction, if not regulation and penalization, is another matter that might well come to the fore at this time of readjustment, a matter deserving consideration by the National Electric Light Association, the Association of Edison Illuminating Companies, and similar bodies. One of the largest utilities in the country already has under advisement the use of power-factor corrective apparatus for all motors in industrial plants above a certain size.

The automatic substation is due for more recognition than it has as yet received. Automatic stations without attendants are now in use for converting alternating to direct current for railroads and mine operation. Steel mills are taking up the automatic remote controlled motor-generator substation and the automatic hydroelectric power plant is now well known. The use of automatic pole-type feeder regulators, on poles or housed, are finding wider adoption and their application in many instances would undoubtedly effect a saving of copper while improving service. In one case plans have already been drawn up for a 60-cycle transformer and distributing station of some 3000 kilowatts, to operate without attendant in supplying city load. Just as the outdoor substation has proved the fallacy of housing what need not be housed, so the automatic installation will prove the waste of effort that accompanies watching equipment that does not need watching.

With the resignation of Dr. Garfield will end the work of the Fuel Administration as a war measure. The work of this body has been one of the most popular and successful. Moreover, the work has been such that it will be continued in spirit and substance long after the Fuel Administration has ceased. Coal saving will remain a vital need of the nation, and in fulfilling this need the central stations must to very large extent take up the work that we fear and regret will be relinquished by the Fuel Administration. The work of rehabilitating power plants, making isolated and industrial plants more efficient will go on, and we hope it will go on with the vim that has proved as rich in results as it has been pleasing. But the experience of

the last long eighteen months has proved beyond dispute the influence of centralized power generation upon fuel economy.

Much of the magnificent research occasioned by the war will go on, and new materials, new processes, new industries and new demands will undoubtedly be made upon the central-station industry. The central-station industry and each and every central-station company is facing its many problems today. These problems are extremely important and some are difficult, but the situation is satisfactory, probably when taken all in all the most satisfactory in the prosperous history of the central-station industry.

Scientific Manipulation of Power Plant Units

IN POWER plant operation there is a rather natural tendency to let well enough alone. However, to do so does not imply that conditions are such as to permit of maximum economy. The reverse is, in fact, the case, and conditions become hit and miss at best.

In the endeavor to save coal, the boiler room has received much attention. Attention should also be accorded the performance of turbine, condenser and auxiliaries. The performance of neither turbine or condenser remains the same for any length of time, and gradual falling off of efficiency, and therefore economy, is bound to occur. Turbine efficiency goes down with length of time in service because of various causes, the more apparent of which are corrosion and erosion of the blades, and the precipitation of foreign matter upon them, variation of clearances, settlement of bearings, etc. Condenser performance becomes poorer with time, and often with the seasons, as air leakage occurs, and as surfaces become fouled by dirt, scale, oil and other matter carried over by the steam or taken in with the cooling water.

Variations of performance of any unit can best be brought to light only when the best operating characteristics of that unit are known. Deviation from the orthodox is then readily noticed, the cause found and remedied and maximum efficiency obtained once again. Every turbine delivers a kilowatt-hour on a minimum pounds of steam at some definite load—that is, there is one point on the efficiency or water-rate curve where efficiency is highest and the water rate the lowest. Maximum coal saving occurs when the unit is operated at this load. Elsewhere in this issue will be found a lengthy discussion on the economical operation of steam-turbine stations, covering the subject from the aspect of fuel saving. The most efficient loading for the station units is determined and whenever possible the units are operated at their maximum efficiency rather than at their pro rata capacity for maximum over-all efficiency.

Each turbine should be tested through its entire range not less frequently than every eight weeks of actual operating time if exact knowledge of conditions is to be obtained. The water-rate curves of the various units should be studied, and the results of the study applied in the operation, the taking on and off of the various units in a station being finally a compromise between economy on one hand and reliability or reserve on the other. What applies to the respective units in a station applies equally to each station operating in parallel in a system—that is, each station should be treated as a unit of the whole, with the difference that in this case the energy losses of transmission lines might become a modifying factor.

The modern efficient central station is really undergoing a daily, weekly or monthly test as a matter of routine. Economy requires eternal vigilance.

Introducing Science into Electrical Contracting

RADICAL developments are taking place in the electrical contracting business ever since Mr. William L. Goodwin made his famous address at the New Orleans convention of the National Association of Electrical Contractors a little over a year ago. Not only has the association been reorganized but also state and local associations have been and are being reorganized along the lines advocated by what has come to be known as the Goodwin Plan. One of the things Mr. Goodwin called attention to last year was the need for this industry to get on a substantial basis of facts by the compilation of cost data and other means which would eliminate the haphazard guesswork that has been so prevalent in this business for many years.

In our last issue we referred to the development of scientific estimating, which is being worked out through a system of standardized estimate sheets, carefully compiled labor cost data, and other exact methods to replace guesswork. In the current issue we report a meeting in which the very important subject of overhead expenses was discussed and a step taken toward bringing this elusive subject into tangible form. The Chicago Electrical Estimators' Association deserves a great deal of credit for the valuable work it has done for bringing about these important developments. As was pointed out in these columns some months ago, it is to be hoped that this work will continue and that the electrical contracting fraternity will come to realize the importance to it of the introduction of exact and scientific methods in place of the slipshod and often very questionable practices that have prevailed for so long.

This proves incidentally that membership in the reorganized electrical contracting associations through which these important measures are being worked out, is of greater value now than ever before, and the officers of these associations should feel encouraged in thus having another most potent argument for increasing their membership.

Week's Events

Mechanical Engineers Meet — Annual Report of National Defense Council—Estimators Discuss Contractors' Overhead

MECHANICAL ENGINEERS DISCUSS MANY TOPICS AT ANNUAL MEETING.

"Engineering of Man Power" Subject of Keynote Session —Army and Navy Nights and Conferring of Honorary Memberships Other Features.

The annual meeting of the American Society of Mechanical Engineers was held in the Engineering Societies building, New York City, Dec. 3 to 6, inclusive. Coming at this time when engineers will be called upon to lead in the readjustment of industry to peace conditions, this meeting was of especial importance. For this reason a varied program including a large number of very interesting talks and lectures on the reconstruction problems was presented in addition to the usual engineering papers and discussions.

Two evenings of the convention were devoted to the engineering work of the Army and Navy during the war. At these sessions illustrated lectures on the "Achievements of Naval Engineering in the War" and the "New Heavy Railway Artillery" were presented. The keynote session dealt with the broad problems of labor and the human relations in industry. At the opening session, honorary memberships were conferred upon Charles M. Schwab and Orville Wright. Charles T. Main, president of the society, presided.

Among the many interesting papers presented were the following: "Industrial Power Problems," by W. F. Uhl; "Daylight vs. Sunlight in Sawtooth Roof Construction," by W. S. Brown; "The Conservation of Heat Losses from Pipes and Boilers," by Glen D. Bagley; "Chemical and Physical Control of Boiler Operation and the Application of Simple Formula for Estimating the Heat Loss Items," by E. A. Nehling; "The Cooling Losses in Combustion Engines as Affecting Design," by C. A. Norman; "Valves and Fittings for High Hydraulic Pressures," by W. W. Gaylord, and the "Determination of Stresses in Wire Rope as Applied to Modern Engineering Problems," by J. F. Howe.

PAYMENT OF UTILITY SERVICE BILLS SHOULD BE PROTECTED.

Pressure Cannot Be Brought on a Customer's Business for Failure to Pay His Residence-Service Bill.

An interesting decision has recently been handed down by the Public Service Commission of Pennsylvania, in a case brought against the Harrisburg Gas Co. by one of its customers for the discontinuance of service. A precedent was established by the Commission when the company was ordered to resume this service, with an existing bill unpaid. The customer was in arrears $57.30 for gas used for domestic consumption, and the company discontinued service at the business establishment of the complainant, renewing only upon promise of payment of the arrears. In its decision, the Commission says, in part:

"Depriving the complainant of a supply at his place of business because of a prior delinquency at his residence was a violation of the rights of the complainant, even though he had specifically promised to pay the old bill as one of the conditions imposed by the company before such service was granted him.

"Such conditions should not have been imposed. The company by so doing was merely trying to recoup the loss sustained by it at the complainant's home, which loss was due to its own neglect. The Public Service Commission law permits the requirement that charges be paid in advance or that a deposit be made to secure future payments of such charges or the supply can be shut off at the first delinquency. The respondent in this case failed to take these precautions. It lost the protection afforded by the act and then, instead of pursuing the ordinary legal processes for the recovery of its debt, it attempted this short-cut method of collection. The act of the company was arbitrary and oppressive and should not be sustained."

CANCELLATION OF WAR CONTRACTS AFFECTS PACIFIC COAST PLANTS.

Recent Order Stops Work on 70 Ships—Cessation of Airplane Construction Ends Activity in Spruce Production.

The cancellation of Government contracts for the construction of wooden ships, as announced Nov. 25 by the Emergency Fleet Corporation, applies to contracts on which work was either not begun or not very far advanced. The order affects about 20 wooden-shipyards on the Pacific coast and stops work on between 60 and 70 ships. The effect is rather serious in the Oregon district, where at Portland, Vancouver, Astoria and other river ports the cancellation order affects 29 ships representing contracts amounting to $19,525,000. Of the contracts let for 150 ships to Oregon yards, 35 have been completed and delivered, 35 others have been launched, and about 50 hulls are on the ways in various stages of construction, which probably will be completed.

As to the 29 or 30 ship contracts cancelled, much of the material and machinery has been purchased, and timbers for frames cut. The general result is the laying off of many workers and an endeavor to secure private contracts. The Emergency Fleet Corporation has directed that such contracts may be entered into with American ship owners, but this affords little relief, as the interests in the market for more ship tonnage, as far as the Pacific coast companies are concerned, are mostly foreign.

The wooden-ship yards on Puget Sound are almost as seriously affected, work having been stopped on about 20 wooden ships. In a similar manner contracts placed with several California yards have been cancelled.

The action taken, while considered very precipitate,

leaving the shipbuilders unprotected from financial losses, is one of the inevitable consequences of the quick change from war to peace. It is very probable that arrangements may be made to transfer a good many of the contracts to private concerns, either American or foreign, though there may be some delay.

The cancelled contracts for at least 60 ships on the Pacific coast affects many lines of material and equipment, including the electrical work, which in the aggregate amounts to a large item.

The cessation of the war also resulted in bringing to a halt all work by the Spruce Production Division of the War Department in getting out and sawing spruce timber for airplanes. This phase of timber activity in Oregon and Washington, which had reached tremendous proportions, came suddenly to an end, creating the problem of diverting the logging roads, sawmills and cut-up plants to other uses as quickly as possible. Two of the spruce sawmills, for which extensive steam and electrical equipment had been ordered and delivered, are being completed by the Government. One of these is in Oregon and the other in Washington.

In connection with wooden-ship cancellations and the shutting off of all work in the spruce woods for airplanes, the timber industry of the Northwest now finds it necessary to look to private enterprise almost entirely. However, it is expected that the additional requirements for buildings, piling, pole lines, railroad work and mine timbers will surely produce the market desired.

COUNCIL OF NATIONAL DEFENSE ISSUES SECOND ANNUAL REPORT.

Summary of Work of the Council an Interesting Contribution to History of the War.

The second annual report of the Council of National Defense, composed of the Secretaries of War, Navy, Interior, Agriculture, Commerce and Labor, just made public, in reviewing the story of the work of the Council during the fiscal year ending June 30, tells also the story of a very large part of the Government's activities in the war of a non-military character. Particularly is this true of the transition period included in the first six or eight months of the war, during which the initial mobilization of the country's industrial and commercial resources took place. The present report becomes, therefore, an important contribution to the official records of the war.

The report is made by W. S. Gifford, director of the Council, until Nov. 1, to the Secretary of War, as chairman, to be transmitted by him to the President for submission to Congress. At the end of the period covered by the report, Mr. Gifford points out, the work of initial mobilization, the main task which the Council undertook in the emergency, was largely completed. The Council set out to act as a connecting link between the nation in its normal state and the nation as a machine for making war. This transition period past, the Council's role as a main link in the war government naturally became less active, though it continued to perform functions of a most vital and necessary nature, especially through the great council of defense system, made up of state, county, municipal and community organizations, reaching practically every hamlet in the country.

A perusal of the report shows that the Council served as a nucleus for innumerable new functions and relations which the war made necessary and for which no administrative agency existed at the outbreak of the conflict. Some of these after being initiated and partially developed by the Council were passed on to existing executive departments, for some the Council created new agencies, either acting under its jurisdiction or given separate jurisdiction, by executive order or Congressional act.

Perhaps the best example of the latter case was the War Industries Board, whose work was begun and developed by the Council and which was separated from it on May 28. Other tasks which received their initial impulse from the Council were: The food conservation program, aircraft program, war labor administration, housing and many functions supplementary to those of the regular departments such as those involved in the storage, shipping, transportation, fuel and medical problems.

The report emphasizes that in mobilizing America's material resources for the Government, the Council has at the same time been vitally concerned in the mobilization of the national spirit. In the effort the Council has been aided particularly by the organizations under the State Councils Section with its State, County, Municipal and Community Councils numbering well over 100,000 at the date of the report.

The report is divided into three sections, the first dealing with the history of the branches of the Council still under its jurisdiction, the second with the War Industries Board up to May 28 which includes much of its most significant work, and finally the story of the agencies dissolved or transferred to other jurisdiction during the year. Among the latter is the highly impressive story of the Commercial Economy Board, transferred in May to become the Conservation Division of the War Industries Board, which sums up almost the whole story of commercial conservation.

In the history of the War Industries Board is summarized the Government's policy in meeting the tremendous demand of the Government departments for steel, copper, lead, tin, for finished products of all kinds and the way that they were met; the story of the transference of plants from peace to war work; the story of the transformation under war conditions of the Government's purchasing policy, and the initial development of a general industrial policy.

Particularly valuable from the historical point of view as well as that of immediate interest is a record of the development of price-fixing, which had its beginnings in the early days of the Council of National Defense with informal voluntary agreements on prices negotiated between representatives of industry and members of the Advisory Commission and of the Council Staff. The report reviews the story of the way in which these informal agreements with nothing but voluntary co-operation to bind them developed finally into a definite price-fixing organization under the War Industries Board. From similar modest beginnings, the original first attempts at regulating priorities through voluntary co-operation developed into the existing large priorities organization, which at the time of the date of the report was issuing hundreds of orders with binding power behind them.

"Special acknowledgment," the report says, "should be made of the valuable activities of the National Research Council which has served as a department of the Council of National Defense, mobilizing and directing the research work of the country's scientific men. Its work has been invaluable in giving the Government war agencies the benefit of scientific research, both directly and indirectly applicable to the purposes of the war."

COMMONWEALTH EDISON TO RE-EMPLOY ALL MEN IN SERVICE.

Position Waiting for Every Former Employee.

Former employes of Commonwealth Edison Co., Chicago, who have left the company's service to enter the service of the United States Army or Navy in this war, and who come directly to the company after honorable discharge from the United States military service and apply for reinstatement, are to be taken back into the company's service immediately. That is in brief the policy which the company has now adopted at the direction of Pres. Samuel Insull. All heads of the departments and the employment bureau have been notified that this policy is now in effect, and they are already governing themselves in accordance therewith.

The rule, as formerly adopted by the Advisory Committee, states that these men will be reinstated in the same position if possible or in some other suitable position in the same department in which they were formerly employed; and that, if there are no vacancies in the position or department in which the man was formerly employed, then, wherever necessary, the employe now filling the position may be transferred to another department where his services can be utilized to make room for the returned soldier; and also that the present employes, if efficient, shall be retained in the service of the company, even if it is necessary to thus transfer them.

Another point covered is that it is the company's intention not only to place the men returning from the military service of the United States in their former positions, but also that they shall be given the present rates of pay of the positions in which they are placed. This latter provision is a very important one in many cases, as will be understood when it is remembered that the scale of pay is now higher in general than it was in 1917.

Where requests are made by men now in the United States service for a letter stating that they will be given a position as soon as they receive their discharge from the service, heads of departments or the employment bureau will write a letter stating that positions are available for them in the company's service.

WAR BOARDS RECOGNIZED BY PITTSBURGH MEETING.

At a meeting of the Pittsburgh Advertising Club which was addressed by C. A. Tupper, president of the International Trade Press, Inc., Chicago, it was suggested by the speaker that resolutions expressing appreciation of the hard, unremitting labors of the various War Industries Boards and other work voluntarily done by the business men of the country in behalf of the Government would be very appropriate. On motion of F. S. Montgomery of the National Metal Moulding Co., a committee was accordingly appointed to draft such resolutions and the following subsequently submitted.

The work of the Army and Navy in the winning of the war has been crowned with the success which was anticipated; too much praise cannot be bestowed upon the personnel of these two branches of the offensive and defensive forces of the country. Many have laid down their lives that Liberty and Democracy might not perish, many have been grievously wounded; practically all have made sacrifices that they might respond to the call of their country in its hour of need. The records these forces have made will be written on the brightest pages of American history.

Much has been written and published of the work of the industrial forces of the country and of what they have done toward backing up the armed forces. What they have done has been none the less essential than that of the men in the first line trenches; what has been accomplished during the comparatively short time in which the United States was in the war before it was fought to a successful conclusion has been the marvel of the age. Labor and capital, putting aside all differences for the duration of the war, united in putting forth every effort to supply the necessary munitions and supplies. Ships were built in record time; arms, munitions and supplies of every kind were turned out in undreamed of quantities, and we all know the result.

Little, however, has been said or written of a large number of men who, at great personal and financial sacrifice, have set aside all other matters and freely given their services to the Government; the splendid work they have done has not been spectacular; their efforts have received little recognition, but some ridicule. What they have done, however, is known by the well informed to have been just as essential in the winning of the war as the work of either the armed or industrial forces. Much that they have done has necessarily had to be kept secret, but when the final pages of the history of this war have been written, the accomplishments of the so-called "Dollar a Year Men" will merit the commendation and approval of a grateful people; therefore, be it resolved

That the Pittsburgh Advertising Club go on record as expressing their approval and appreciation of the work, entailing no little sacrifice, of those men who, without consideration of their private and personal affairs, volunteered their services to the Government, this without compensation or the hope of any reward other than the knowledge that their services were essential in a time of national need.

This resolution was unanimously adopted.

PUTTING "OVERHEAD" ON A SCIENTIFIC BASIS.

W. L. Goodwin Addresses Chicago Estimators and Contractors on Important Subject.

Further proof of the progressiveness of the Chicago Electrical Estimators' Association was brought out at its latest meeting, held Dec. 3 at the Morrison hotel, Chicago. At this meeting, W. L. Goodwin, who has given the Association considerable help in the past in the bringing out of its many improvements, addressed the members. Members of the Chicago Association of Electrical Contractors and Dealers were also invited and quite a few of these were present and took an active part in the discussion. A. McWilliams, president of the association, presided at the meeting.

The object of the meeting was to decide as far as possible the extent of the overhead expenditure of the electrical contractor. It is well known that this overhead charge is probably the least understood and most unruly item entering into the finished estimate. As a result, overhead has probably stolen more profits and killed more enterprises than any other item entering into business cost. The Estimators' Association recognized some time ago, that before the contracting business could be placed on a secure and stable basis,

this problem must be solved. Accordingly a committee was formed which, after an exhaustive study of the situation, presented at this meeting one of the best solutions so far devised.

It was decided early in their investigations that precentages of the annual business or any other method which involved the average percentage of a number of jobs of different sizes would not suffice. This was the result of the well-known fact that the percentage of overhead is much higher on a small job than it is on a large one. For this reason, any average percentage for jobs involving different amounts would overtax the overhead on a large job to make up for the loss created by underestimating it on a small one. This condition would be but little better than the existing condition.

The obvious remedy, therefore, is to change the percentage of overhead charged to jobs of different sizes. In accordance with this scheme the committee arranged a tentative curve which gave the approximate percentages to be charged to different jobs according to their size. A description of this curve and the conditions which led to its adoption were presented by E. L. Morley, of the L. K. Comstock Co. This curve, which starts with 52% for a job costing $200 and reaches a practically horizontal line at 8.5% for jobs of $160,000, will be reproduced with the full text of Mr. Morley's address in an early issue of the ELECTRICAL REVIEW.

In opening the discussion Mr. Goodwin complimented the Association on the unparalleled progress which it has made since its organization. He then suggested that this curve be immediately adopted by contractors, but to perfect the plan recommended that on account of the varying amount of supervision necessary, for example in wiring a factory as compared with a church having the same cost, auxiliary curves covering the different classes of instaliations should be drawn up.

In the active discussion which followed, many interesting and instructive points were brought out which proved the growing necessity of such a curve to the contracting business. That something must be done to stabilize the prices, which were often so widely distributed as to cause owners to decide to do their own work, was the general idea expressed by many of those present. Among those who took part in this discussion were: G. A. Kohler, Kohler Bros.; John R. Smith, Freeman-Sweet Co., secretary of the Association; Albert Uhl, Henry Newgard Co.; L. H. Lamont, L. H. Lamont & Co.; William McGuineas, United Electrical Construction Co.; W. A. Jackson, W. A. Jackson Co.; C. G. Rush, C. G. Rush & Co.

A list of items which make up the permanent portion of the contractor's overhead expenses was presented by Mr. Smith. The principal items in this list were: Salaries, including all salaries other than actual labor costs which average 3/5 of the total overhead expense; sales expenses; legal expenses; operating expenses, including rent, tool expenses, interest, depreciation; sundries, such as stationery, printing, etc., deliveries, taxes and insurance.

Mr. Goodwin, then delivered a very interesting address, covering a variety of subjects, all of which are of vital importance, not only to the electrical contractor and estimator, but to the industry as a whole as well. The spirit of co-operation which had already produced such remarkable results among the estimators and contractors should be enlarged to include other branches of the industry if the best results are to be obtained. In Chicago, he explained, this can best be accomplished by a closer co-operation between the contractors and the jobbers and suggested that immediate steps be taken by the contractors to extend their efforts in this direction. Citing the conditions that existed on the Pacific Coast, in the readjustment of which he played an important part, and which in many respects were similar to those at present existing in Chicago, he pointed out very forcibly the advantages which can be derived from such an alliance.

The difficulties that await the contractor who specializes in one class of installations to the exclusion of other classes were brought out with considerable emphasis. Mr. Goodwin firmly believes that only the advent of the war saved from bankruptcy, many of the larger contracting companies, who refused to accept small jobs. By specializing, he pointed out, the slightest change in conditions in any particular branch of building is very apt to have a disastrous effect upon the contractor, whereas, if a contractor endeavors to do various kinds of work, from the small house-wiring jobs to the installation in large factories and office buildings, the changes which are bound to occur at certain periods and which seriously affect certain industries will not affect him.

In closing, Mr. Goodwin called attention to the laxity of contractors in continuing their relations with customers whose premises they wire. The contractor should not be satisfied with merely installing the original wiring but should endeavor to continue and extend his operations. As the first electrical man on the job the contractor has a distinct advantage over the jobber or manufacturer in selling the customer his apparatus and appliances. In addition, a sincere effort should be made to contract for the maintenance of the plant. When this condition is reached, that is, when contractors have stores at which they sell appliances, etc., and the maintenance of electrical equipment is done by contractors on a contract basis, then only will the contractor occupy the position in the electrical field to which he is entitled.

Electrical Review's Street-Lighting Schedules for 1919 Are Ready.

Conforming with its annual custom of long standing, the ELECTRICAL REVIEW has prepared street-lighting schedules for the year 1919 on the two most used systems—the "all-night" and "moonlight" systems. As usual, the schedules are published in convenient booklet form, the tables proper being printed on a single sheet that may be detached for mounting as a wall calendar, if desired.

The booklet contains much valuable information pertinent to the subject, such as the rules on which the schedules are based, explanation of how the tables may be used for modifications and combinations of the schedules given, instruction on corrections for standard time and latitude, a complete table of monthly and yearly totals for the two common schedules and three others derived therefrom, rules for finding the totals for other modifications of these five schedules, and the effect of "daylight saving" on street lighting. The tables as given make allowance for "summer time," prevailing from March to October, so that the hour adjustment for these seven months is not necessary. Copies of the booklet are obtainable for 25 cents.

For municipalities and lighting companies that may wish to have special street-lighting schedules, correct for the standard time and latitude of their communities, the ELECTRICAL REVIEW's lighting specialist will prepare such schedules at cost. Complete tables of the actual number of hours and minutes of lighting on each night for any of the five schedules totalized in the booklet can be furnished at the cost of copying.

Commercial

Co-operative Buying Plan for Central Stations – Timely Merchandising Suggestions for the Central-Station Men

CENTRAL STATIONS CONTINUE CO-OPERATIVE BUYING PLAN.

Program for Portable Lamp Production for Next Year Nearly Completed.

On Dec. 7, representatives from the merchandising departments of a number of central-station companies, including the largest such companies in the country, will hold a meeting at the plant of the Edward Miller Co., Meriden, Conn. At this, the second such meeting to be held, the other taking place about a year ago, the arrangements for the continuation of the plan which was adopted at the former meeting will be completed. This plan was originated by E. A. Edkins of the Commonwealth Edison Co., Chicago, and has for its purpose the producing of portable electric lamps which can be sold at a much lower price than is possible under ordinary methods of production and distribution.

Among the central-station companies expected to be represented at this meeting are: Commonwealth Edison Co., Chicago; Henry L. Doherty Co., New York; Narragansett Electric Lighting Co., Providence. R. I.; Edison Electric Illuminating Co., Boston; Union Electric Light & Power Co., St. Louis; Philadelphia Electric Co., Philadelphia; Potomac Electric Light & Power Co., Washington; Consolidated, Gas, Electric Light & Power Co., Baltimore; Public Service Co. of New Jersey, and the Edison Electric Illuminating Co. of Brooklyn. Through these companies and the Edward Miller Co. the lamps decided upon will be distributed directly or by mail order to the consumer and dealer.

Library Table Lamp Produced by Quantity Production Method.

As has been stated, this plan was started about a year ago, but due to the high prices of materials and other war conditions, production has been very limited. For this reason many dealers were unable to secure a stock of these lamps. The program for the next year, however, has been greatly enlarged to meet the increased demand that is sure to develop now that the war is over.

The idea of the plan is to lower the prices of certain types of lamps by standardizing the styles, thereby increasing the production and to combine the purchasing power of the subscribing central-station companies to underwrite the entire output of these lamps. As is well known the overhead expense, including the designing, making of the dies, marketing, etc., of lamps is extremely high, often amounting to 200% of the actual material costs. The savings made possible by reducing this overhead expense are, of course, correspondingly great.

The extent of this saving can be readily appreciated from the results obtained. For example, the table lamp illustrated was sold under this plan at least 50% lower than any other similar products of comparative value on the market. This lamp has an antique-bronze-finished base with an opal-glass shade. It is completely equipped with two Cutler-Hammer sockets, 8 ft. of silk cord and a Hubbell plug. In addition to this table lamp, three other styles—a floor lamp, a boudoir lamp and a utility or desk lamp—were produced on the same basis.

Although this co-operative quantity-production plan is especially adaptable to the production of portable lamps, it is believed that benefits nearly as great can be derived from its introduction into many other branches of electrical merchandising.

INDIVIDUAL BLOWERS INCREASE FURNACE CAPACITY.

Much discussion has centered around individual *versus* group drive in factories, and each case must be decided upon its own merits. A recent instance in an iron foundry where individual drive was found extremely profitable may be of interest.

The Waukesha Malleable Iron Co. was using a 50-hp. motor to drive a forced-draft blower for four furnaces producing malleable iron. A change was made from one blower for all four furnaces to an individual blower for each furnace. Each blower was driven by a 7½-hp. Ideal type D motor, shunt-wound for 115 volts. The change in motor horsepower was from 50 to 30 hp., representing a considerable saving.

But there were greater changes made in the cost and quantity of production. Whereas, with the one blower 18 working hours were required to turn out two heats, only 10 working hours were needed for the two heats with the individual supply of air blast per

furnace. Moreover, individual air supply to the four furnaces reduced the coal consumption 1½ tons per furnace per day, 6 tons of coal saved per day for the four furnaces. Individual motor drive was obviously advantageous in this case.

TIMELY SUGGESTIONS OFFERED AS AID TO CENTRAL-STATION MEN.

Results of "Save-by-Wire" Campaign—Hints on Relation to Customers and Employes.

The "Save-by-Wire" campaign started in September by the Society of Electrical Development, Inc., of New York City, proved many things, the most important of which was that it offers permanent possibilities for central stations—possibilities for increased business without necessitating expensive line extensions, without requiring additional capital and without greatly increasing the business-getting force. Reports are coming in from central stations throughout the country where the campaign was carried on which show the great possibilities and advantages to be derived from this method of increasing the use of electricity.

In the *Monthly Sales Service* for December the publication of the society, J. G. Learned of the Public Service Co. of Northern Illinois estimates that a convenience outlet in the dining-room is worth 50 cents a month to the central-station company. Furthermore, he believes that the solicitation of outlet business will result in the sale of appliances.

In addition to the above, this issue contains many other suggestions for central-station managers.

Securing the New Employes' Co-operation.

Although a large part of the labor which was lost during the period of the war will now return, there are many new employes who will be retained. The loyalty of these new employes in the future will depend largely upon the efforts made by central-station managers now to show them the spirit of the organizations and to secure their co-operation. In this respect the value of organization meetings should not be overlooked. The larger the company the greater the need for such meetings, as it is at them that the new employe will catch the spirit of the organization and become familiar not only with his fellow-workers but with the manner and methods which are used by the company in furthering its business.

Making the Merchandising Department Pay.

One of the discoveries in the business research work of the society is that many central-station operators rarely charge their business rental for the buildings owned by them, or interest upon capital invested by them in their enterprises. In only a few of the larger cities has the merchandising of electrical appliances by the central stations been put upon a strict "make-it-pay" basis. Rent, light, heat, salaries of employes in that department and superintendents, managers and others working part of the time for that department are charged against it. In most central stations there is no fixed basis for charging against the merchandising department all that should be charged against it as a separate and distinct retail establishment. Now that the war is over, the merchandising activities of these central-station companies should be put on a strict paying basis.

Another item of interest to central-station managers is the acquainting of customers and customers-to-be with the company's policies. We are due for great policy readjustments during the next few years. Those central stations which have foreseen the advisability of taking the public into their confidence, of laying their cards on the table—so to speak—will be least affected by any changes that must eventually come.

Do you have to make a charge for your extensions? Do you have to charge for meter reading? Do you have to discontinue free renewals of fuses and lamps? Do you have to do many things that would or could provoke complaint among your customers?

The answer to it all is take your customers into your confidence. Good publicity, straight from the shoulder, is the oil that smoothes the troubled waters.

Activity in Public Affairs.

The chief thing central-station companies have to combat is the spirit of aloofness, of "stand-off-ishness" that their customers are so ready to assume. Check up the most progressive and popular central stations and you will find that almost without exception they mix energetically in all popular civic and government campaigns and movements.

A prominent new-business manager recently said, in explaining the success of his company: "Early in the business we were looked upon with suspicion and doubt just as most companies are today. We were scolded, abused or ignored as the whims of the public blew. We scrupulously refrained from butting into politics; we began an intensive campaign to educate our own employes to the policies adapted by the company. Our men, once educated, have helped us wonderfully. They bring in their friends, they are paid commissions on sales; they have bonus plans worked out for them from boiler-room to sales-floor, and they are reasonably content. In short, they are good boosters.

"Then we mix in all popular movements. We throw our help to the side of any good local or national campaign. Our sales and rest-rooms are popular meeting places. We give entertainments, and we never aim to make a direct profit on any such entertainments. We work with the Commerce Club, the Ad Club, with churches, societies, lodges and sewing circles. We are propagandists, if you choose to call us that. But so long as it pays we will keep at it. And we know it pays because when we had to increase our residence and power schedule, as we did last year, we met with practically no opposition after we laid our cards on the table."

A Merchandising Suggestion.

The influenza epidemic that recently swept the country was the means of many foresighted central-station managers selling many electric "heat-pads" and radiators. Even though the danger of the "flu" is past in your city, you can still capitalize it by putting special sales emphasis on the value of the heat-pad as a preventive of "grippe" and the "flu." We are told by doctors to expect a return of the malady in the late winter or spring. Urge the buying of pads now!

A good plan is to first get the interest of the hospitals and prominent doctors by showing them the device, then either loaning it to them or giving it to them, and using their testimonials to get business. Care must be taken not to offend the physician in getting and using his recommendation. If you don't put a special price on the device, you can at least allow liberal time payments, which will result in good business.

Operating

Fuel-Saving Suggestions—Boiler Part for Economizer—Cost of Steam Generation—Sodium Chloride for Soot Removal

HELPING POWER PLANTS SAVE COAL BY MAIL.

Discussion of the Waste Resulting from Formation of Scale.

While the formation of scale cannot be altogether prevented, in practice, the waste that accompanies it may to very large extent be kept down to a minimum. The sixth general letter sent out to the power plants of Illinois by Joseph Harrington, administrative engineer, Fuel Administration, covers the subject of boiler scale prevention. Study of this letter, which follows, shows the importance of keeping boiler surfaces free from scale as much as possible, preferably by treating the water before it enters the boiler. Mr. Harrington's letter covers the matter in the following manner:

BOILER SCALE PREVENTION.

"The importance of this subject can be appreciated better when you realize that no boiler is without scale and that all scale results in fuel loss. Exceptions to this rule are so few as to be negligible.

"The very fact that you have to use a tube cleaner or turbine is sufficient evidence to prove that you have scale. It makes no difference whether you turbine your boilers once a week or once a year, the average thickness of scale is equal to one-half the thickness at the time of removal. Another thing you must not overlook, and that is that the only proper place to remove the scale forming elements is *before* the water enters the boiler; and another equally important fact, that this is a perfectly possible and economical thing to do.

"Very careful and extensive experimentation in this matter was conducted by Professor Schmidt at the University of Illinois and the following table is based on the results of his researches:

TABLE A.

Character of scale.	Thickness, in.	Composition.	Loss of efficiency %
Hard	1/50	Mostly carbonate.	5.4
Soft	1/32	Mostly carbonate.	7.2
Hard	1/32	Mostly carbonate.	8.5
Soft	1/25	Mostly carbonate.	8.0
Hard	1/25	Mostly sulphate.	9.3
Hard	1/20	Mostly sulphate.	11.1
Soft	1/16	Mostly sulphate.	10.8
Soft	1/16	Mostly carbonate.	11.0
Soft	1/16	Mostly carbonate.	12.4
Hard	1/16	Mostly carbonate.	12.6
Soft	1/11	Mostly carbonate.	15.0
Hard	1/9	Mostly sulphate.	15.9

"Do not content yourself with the thought that you are having no trouble with scale. You can only have no trouble when you have no scale. Why wait until you have bagged your boiler, burned out tubes or wasted a lot of coal before taking action in this matter? Impress upon your memory the fact that the first thin layer of scale is the most injurious. Stated somewhat more scientifically, the rule is that the insulating effect varies as the square root of its thickness. To illustrate, the insulating effect of scale of thicknesses 4, 9 and 16 is 2, 3 and 4. Scale of the thickness of 4 insulate 2, while it requires a thickness of 16 to insulate 4, or four times as much scale to produce twice the insulating effect.

"To give this matter point and talk in terms of coal, the following table is given:

TABLE B.

Average thickness of scale.	Coal wasted from every ton fired.
1/50	100
1/32	140
1/25	180
1/20	200
1/16	220
1/11	300
1/9	320

"The use of boiler compounds is unquestionably better than no treatment at all, but it seldom, if ever, accomplishes real satisfactory results. If the compound is a chemical and reacts with the scale-forming material in the water, it can only change this material to something else which is commonly known as sludge. When this occurs, the sludge is deposited on the boiler heating surfaces as a soft mud-like substance which is not scale but which has an insulating effect and which, if excessive, may actually result in burning the plates of the boiler. To avoid its becoming excessive, the boiler is blown down frequently which is a direct loss of heat and waste of coal.

"You will observe, from the foregoing, that the writer takes no middle ground in this matter. There is only one right condition, and that is perfect cleanliness. If you think that there is an objection to properly softening your boiler feed-water in advance of pumping it into the boilers due to the cost of installation, look over the second table above and figure out what it costs you now per year with your present water and its consequent scale. You will find, that in all probability the cost of proper water treatment would be paid for inside of two years including the cost of operation. Water as pure as Lake Michigan water comes in this class.

"In conclusion, remember that it is possible to so purify your water that *no scale* will form in your boilers.

"Will you please, therefore, start immediate investigation as to the matters considered above?"

USE OF BOILER PARTS FOR ECONOMIZER.

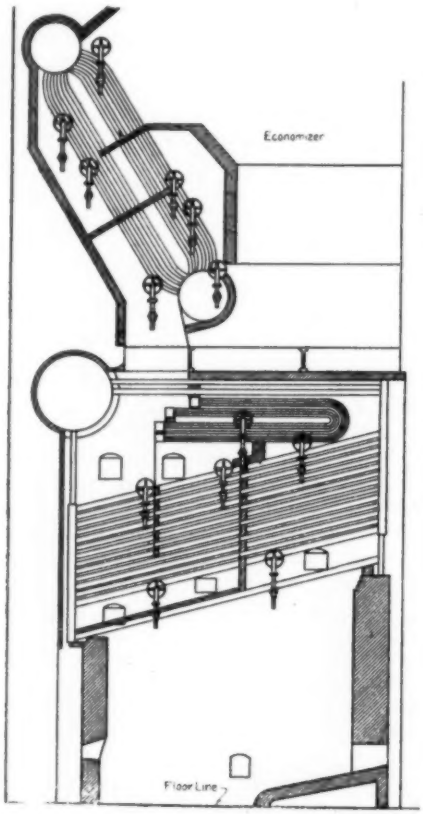
Interesting Installation by Kansas City Light & Power Co.

There are at present six 1300-hp. B and W boilers with 13,512 sq. ft. heating surface in the Kansas City Light and Power Co.'s Northeast station. The working pressure is intended to be 300 lb. and the evapora-

tion per boiler between 70,000 and 120,000 lb. per hour with feed-water temperature at 220° F. Each boiler is served by a Sanford Riley stoker. An economizer is installed to each boiler, their respective heating surfaces being 4000 sq. ft.

The economizers are built of standard parts of Stirling boilers, and were also supplied by the B and W Co. The use of Stirling boiler sections saved time in delivery, reduced cost and at the same time satisfied the requirements imposed by the operating pressure.

Diamond soot blowers are used for removing soot on both boiler and economizer heating surfaces. The use of soot scrapers for the economizers with tubes located and of the shape that are those of the econ-



Use of Stirling Boiler Section as Economizer, Showing Location of Soot Blowers.

omizer, would be a difficult proposition. Moreover, scrapers are inefficient, expensive and troublesome to maintain, causing air leakage, grinding in of the soot instead of removing it, hiding defects in the tubes, tending to cause corrosion. Soot blowers overcome these defects and enable higher heat conductivity.

Each boiler has six soot blower units on each side with 21 nozzles each, the economizer six units of 19 nozzles on each side, and the superheater two units. Two units are installed for each pass of the boiler. The first set of nozzles are seen to be located directly above the front wall where they are able to keep the first rows of tubes free of clinker and flue-gas dust, at once corrosive and otherwise objectionable because interfering with heat transfer obstructing the gas passages, etc.

Six minutes actual blowing time is required to blow the soot of each boiler and the steam consumption is about 2600 lb. of steam. The time and steam consumption for cleaning the economizer is the same.

REMOVAL OF SOOT FROM HEATING SURFACES AND FLUES.

Use of Salt Removes Heat-Insulating and Draft-Choking Soot.

By Joseph Harrington,
Administrative Engineer, United States Fuel Administration.

One of the most difficult problems which conservation engineers in the state of Illinois encounter in the burning of local coal in both steam boilers and house-heating furnaces is the removal of the excessive deposit of soot and tarry substances on the cold heating surfaces of the boilers. This tar or soot has an insulating value far in excess of any commercial insulator. One-eighth of an inch of soot on a boiler reduces the transmission of heat approximately 10% for 1/32 in., and 20% for 1/16 in. In view of the well known fact that heating surfaces quickly become covered with soot as thick as the foregoing, the great importance of some method of removing it becomes apparent.

It gives the writer considerable pleasure to be able to advise both power plant and domestic operators of boilers that a method has been discovered whereby it is entirely feasible to remove soot without the necessity of letting down the boiler, or additional expenditure of labor. It is my pleasure to acknowledge the debt I owe to C. J. Causland, electrical engineer of the Pennsylvania Railroad Co., Chicago district, and Jerome Kohout, chief chemist of the Commercial Testing & Engineering Co., Chicago, for their suggestions and assistance in developing the facts relating to this process.

This process is, in brief, the application of common salt to the fire under conditions which will produce dissociation of the sodium and chlorine forming the salt and the subsequent combination of these elements with the carbon of the soot to form a substance which then passes off as a gas or drops off of the heating surface. The practice is briefly as follows:

The fire is put into good condition with a substantial body of hot fuel. Common salt, previously dried, is then thrown or sprinkled onto the incandescent fuel bed in a quantity depending entirely on the size of the furnace. In the case of a household furnace a pound at a time is ample; in the case of a large power plant boiler, four or five scoops full may be required. The dampers are kept open so as to maintain the furnace temperature and the salt is allowed to remain until the fumes have entirely disappeared.

Immediately upon charging the salt, the furnace becomes filled with dense, white fumes, which may require as much as half an hour to entirely disappear. If results are not secured on the first application, it should be repeated as many times as necessary. Once the heating surface is thoroughly cleaned, a small application every few days is usually sufficient to keep it so.

Common salt is composed of only two elements—sodium and chlorine. Both are very reactive substances; the first, a metal, and the second, a corrosive gas. When salt is thrown upon incandescent coal, it is vaporized and probably decomposed, at least in part, into its original elements. The chlorine, being acidic in character, would attack the iron in the iron oxide incrustation and form a chloride of iron. Ferric chloride is volatile in high temperatures and would, therefore, disappear in the form of gas, or at least a sufficient amount would be volatilized to render the

deposit porous and weak and so loosen it that it would fall from the tubes of its own weight.

The sodium of the salt would immediately oxidize to sodium oxide, or sodium peroxide. This material being basic, would not attack iron, but would be carried out of the furnace and deposited with the soot on the heating surfaces of the boiler. The sodium oxide would thus introduce oxygen into the carbonaceous matter in the soot, and at an elevated temperature would cause an oxidization of this material. Carbon dioxide and carbon monoxide are gases which would pass out of the stack with the furnace gases.

The foregoing is more or less hypothetical, but inasmuch as there is no literature or direct experimental evidence of the action of salt in this manner, I am under the necessity of assuming that the above reasoning is at least sufficiently probable to explain the definitely known results that occur.

The application of this method of cleaning heating surfaces, presents possibilities which are of tremendous significance to power-plant owners.

The boiler can be cleaned when in service without the use of special equipment, extra labor or interruption to the use of the boiler. The heating surfaces are cleaned to the utmost corners and two years' experience shows absolutely no deterioration of either brickwork or boiler tubes. It is an economy which represents enormous savings and all the evidence at hand shows it to be thoroughly practical.

In domestic service it frequently represents not merely an economy, but makes possible the use of apparatus which otherwise could not be used. Domestic furnaces get so clogged up with soot that they are absolutely useless and on account of the peculiar construction of some of them, their heating surfaces can not be reached for proper mechanical cleaning. The salt method, therefore, means everything. The actual cost of the salt used is so slight as to be scarcely a factor in the matter.

Try this in your power plant and in your home. Develop the proposition from every angle and see if you cannot benefit from these suggestions. So far as I am aware, no general knowledge of this method exists, and it is my hope that you will be able to very greatly benefit from this publication of it.

GRAPHITE FOR BOILER TREATMENT.

The urgent need for conserving coal has turned attention to many things connected with the power plant that might in normal times have passed unnoticed. Analytical inspections have been made, questionnaires have had to be answered, and many practices and conditions have been changed as a result. Many of the changes, all for the better, have come about with little trouble and often at no expense, showing clear profit in the way of lower coal consumption, lower operating expenses, etc.

A typical incident has been reported by an engineer who had taken charge of a station only a short time previously. In going over the operating expenses and checking up the statements and operating reports of the plant it was found that boiler compound was being used in large quantities for water treatment. The expense account showed that the consumption of boiler compound was the same throughout the months of the year, although the evaporation of the plant varied considerably due the seasons. This fact suggested that compound was being wasted, or at best, that uniform results as regards water treatment were not being obtained, since either an excess of compound was being used at some periods of the year or insufficient amounts at other times.

Operating conditions, however, suggested that excessive quantities of water-treating compound were being consumed. Steam traps were clogged with mud and the turbine blades showed that matter was being carried over with the steam due priming of the boilers and concentration of boiler compound in the water. In other words, not only was money being wasted on the use of needless quantities of boiler compound, but the excess was causing trouble.

The use of compound was immediately discontinued and graphite substituted. Graphite seems to cover heating surfaces with a film that tends to prevent scale from adhering tenaciously. Moreover, each particle of scale seems to become covered with graphite, thus tending to prevent the formation of large masses. By the use of graphite the water-treating expense was reduced about $50 per month; at the same time the trouble due clogging of steam traps and the priming of boilers was eliminated.

It might be pointed out that the place to treat water is not in the boiler but before the water goes to the boiler. And also that graphite is really not for treating scale but for treating the boiler surfaces in contact with the water, although it does influence the characteristics of the scale.

THE COST OF COAL FOR GENERATING STEAM.

The accompanying diagram gotten up by the Westinghouse Electric & Manufacturing Co. furnishes the power plant operator accurate information on the cost of coal for generating steam. Knowing the price, and the amount of coal burned and the quantity of water evaporated the solution is easy. Start with the cost

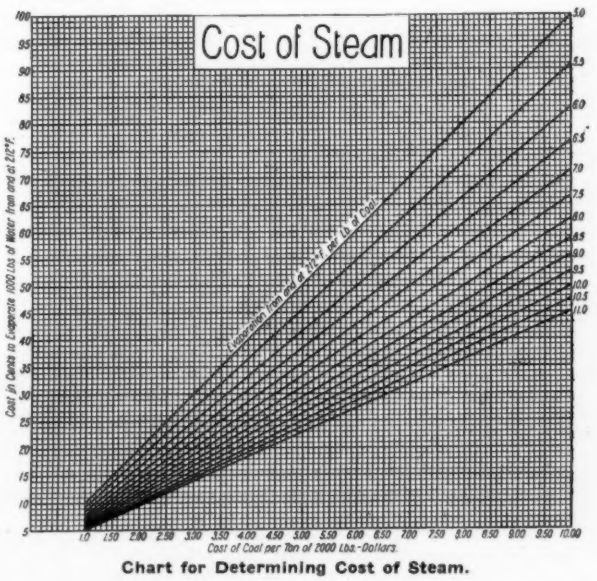


Chart for Determining Cost of Steam.

of coal per ton and project vertically, intersecting the oblique line corresponding to the evaporation from and at 212° F. being obtained from the boilers, then move horizontally to the left margin, where the cost of coal to evaporate one thousand pounds of water from and at 212° F. is given. The chart can also be used to determine the evaporation required to generate steam at a certain cost, by reversing the above process.

Contracting-Construction

Devereux's List of Changes in the 1918 Edition of the National Electrical Code — An Interesting Motor Problem

COMPLETE LIST OF CHANGES IN NATIONAL ELECTRICAL CODE.

President Devereux of the National Association of Electrical Inspectors Contributes Data of Value to Inspectors and Contractors.

Electrical inspectors, contractors and engineers who make continual or at least frequent use of the National Electrical Code must know exactly in what particulars the Code is changed or added to at each of its regular biennial revisions. The most complete list of changes made in the recently issued 1918 edition of the Code has been prepared under the direction of Washington Devereux, of Philadelphia, Pa., president of the National Association of Electrical Inspectors, who has kindly contributed it to the ELECTRICAL REVIEW for the benefit of all readers interested in the subject. The list is too long to publish in this issue and will be concluded in next week's issue. It has been carefully checked and added to so as to include all changes except manifest typographical errors. Wherever reference is made to the former rules, the edition of 1915 is meant.

The full text of the 1918 edition of the National Electrical Code, with additions and alterations indicated in bold-faced type, and with many explanatory notes and illustrations, appears in the "Electrical Blue Book" for 1918, published by International Trade Press, Inc., Chicago, for $2 a copy.

CHANGES IN NATIONAL ELECTRICAL CODE (EDITION OF 1918).

Rule 1, section c, paragraphs 1 and 2.—Changed to conform to Rule 15A.

Rule 1d, par. 3.—Transferred from par. 4 and changed to read: "If a generator not electrically driven supplies a two-wire grounded system, the safety device or devices must be so placed as to disconnect the generator from all conductors of the circuit."

Rule 1d, par. 4.—Transferred from Rule 1*d*, par. 3.

Rule 1e.—Addition to require the rating in kw. for direct current, and kv-a. for alternating current.

Rule 2a, par. 1 and 2.—Combined and changed to require: Conductors to be supported on approved non-combustible, non-absorptive insulators or placed in approved metal conduit, tile or other fireproof ducts, and where exposed to moisture in conduits, must be lead-sheathed and sheathing must be grounded and, except for low-potential systems, the insulation of conductors where leaving the metal sheath of cables must be thoroughly protected from moisture and mechanical injury by means of a pothead or some equivalent method.

Rule 2b, par. 1, 2, 3.—Combined and addition to require that where conductors are closely grouped as on switchboards, in fire towers, cableways, etc., the conductors must each have a substantial flameproof outer covering and busbars of bare metal must be rigidly supported.

Rule 2b, par. 2.—Transferred from Rule 2*b*, par. 4, and changed to read: "Flameproofing must be stripped back on all conductors a sufficient distance from the terminals to give the necessary insulation for the voltage of the circuit on which the conductor is used."

Rule 2c.—Addition to require where conductors pass through floors or fire walls, they must be carried through individual openings in non-combustible, non-abroptive, insulating tubes or their equivalent, and not through a common open space.

Rule 3e, par. 1.—Changed to require insulated conductors to have a substantial flameproof outer covering.

Rule 3e, par. 2.—Change in phraseology to conform to 2*b*, par. 2.

Rule 5, note.—"For construction rules, see No. 82," omitted.

Rule 5c, par. 1 (new).—Requires isolation from all other equipment and, if of the oil-immersed type, must be located outside or in a fireproof room or compartment on the premises.

Rule 5c, par. 2.—Refers all grounding of lightning arresters to Rule 15A.

Rule 6.—Omitted and left blank for future use.

Rule 7.—Heading changed to read: Ground Detectors.

Rule 7a.—Last sentence omitted and grounding referred to Rule 15A.

Rule 7b.—Omitted.

Rule 8a, par. 1.—Addition, frame grounding must conform to Rule 15A.

Rule 8a, par. 2.—Addition, frame grounding must conform to Rule 15A.

Rule 8b, par. 2.—Addition, casings and conduit must be grounded as provided in Rule 15A.

Rule 8b, par. 3.—Addition, omitting the metal sheaths over splices where not exposed to moisture, providing sheaths are belled out and bonded with No. 6 B. & S. gage copper wire and approved ground clamps.

Rule 8b, par. 4.—Changed to permit high-potential motor conductors entering from outside walls to special room or vault to be installed on glass or porcelain insulators.

Rule 8b, par. 5.—Changed to permit the carrying capacity of conductors to be 10% greater than motor rating, instead of 25%.

Rule 8b, par. 6.—Changes to classification of service table, giving 5, 10 and 30-minute, 2-hour and continuous ratings, and changing percentage rating of same. Fine-print note describing varying-speed motors omitted.

Rule 8c, par. 2.—Changed to require a switch on supply side of autostarter or group of autostarters, and permitting alternating-current starters that open all wires of circuits automatically under overload when in running position to serve as circuit-breakers, and requiring separate circuit-breaker or set of fuses when overload release device of a direct-current starter is in operation during process of starting.

Rule 8c, par. 3.—Transferred to 8*c*, par. 2.

Rule 8c, par. 3.—Transferred from Rule 8*c*, par. 4 and reworded.

Rule 8c, par. 4.—Transferred from Rule 8*c*, par. 5, and changed to permit the rated continuous current capacity of a time-limit circuit-breaker to 110%. Fine-print note transfers rated full-load-current table above 100 amperes to the above-30-ampere rating.

Rule 8c, par. 5 (new).—Requires reverse-phase relays on motors operating freight or passenger elevators, or cranes that are dependent on phase relation for the direction of rotation.

Rule 8d, par. 2.—First sentence, relative to enclosing of current-carrying parts of autostarters included in Rule 79*a*, par. 1.

Rule 8g.—Omitted.

Rule 8h.—Transferred to Rule 8*g* and addition to require the interval during which motors can safely operate, starting cold. The time interval given must be either 5, 10, 15, 30, 60 or 120 minutes, or continuous.

Rule 8i.—Transferred to Rule 8*h*.

Rule 8j.—Transferred to Rule 8*i*.

Rule 8k.—Transferred to Rule 8*j*.

Rule 9.—Heading changed from "Railway Power Plants" to "Feeder Protection."

Rule 9, par. 1.—Change in method of installing protective devices.

Rule 9, par. 2 (new).—Requires oil circuit-breakers and switches, wherever practicable, to be isolated from other

switches and electrical apparatus and to be of the remote-control type and be enclosed in separate fireproof cells or compartments when over 7500 volts.

Rule 11a, par. 1.—The word "fire" added.

Rule 11a, par. 2 (new).—Requires the housing of oil-cooled transformers and requires transformers of the air-cooled type to be isolated from other equipment, and if of the air-blast type, should be supplied with air through fireproof ducts.

Rule 11b, par. 1.—Transferred to Rule 11*a*, par. 3, and grounding required as per Rule 15A.

Rule 11b.—Changed to require the grounding to conform to Rule 15A.

Rule 12f, par. 3.—Changed to conform to Rule 15A, except on following conductors: "(1)—Conduit containing no conductor of a circuit exceeding 150 volts to ground may be left ungrounded if insulated from the ground and from the metal conduit, armored cable or metal raceways within the building, and from all metal work on or in the building. (2)—Conduit containing conductors of circuits exceeding 150 volts to ground may be left ungrounded if insulated as above and also isolated and guarded."

Rule 12f, par. 4, 5 and 6.—Omitted.

Rule 12h.—Grounding must conform to Rule 15A.

Rule 14.—Fine-print note omitted.

Rule 15.—Fine-print note omitted.

Rule 15a, par. 1.—Changed to conform to Rule 15A.

Rule 15a, par. 2 (new).—Permits grounding of two-wire direct-current systems if Rule 15A is complied with.

Rule 15a, items 1, 2 and 3.—Omitted.

Rule 15b, par. 1.—Reworded.

Rule 15b, items 1, 2 and 3.—Omitted.

Rule 15c.—Omitted.

Rule 15d.—Omitted.

Rule 15e.—Omitted.

Rule 15f.—Omitted.

Rule 15g.—Omitted.

Rule 15A.—An entirely new rule with sections *a* to *t*, describing method of grounding.

Rule 16b, par. 1.—Reference to split knobs and cleats omitted.

Rule 19a, par 1.—Additional exceptions, see Rule 24*a* and *c*.

Rule 19b, par. 1.—Reworded.

Rule 19b, par. 2.—(Addition.) For exception, see Rules 40*c* and 41*e*.

Rule 20b, par. 2 (new).—Requires a switch, automatic in action, which will indicate whether current is on or off, to close the main circuit and disconnect the branch wires when turned off.

Rule 21.—Note in reference to construction omitted.

Rule 21c.—Reference to Rule 75 omitted.

Rule 22b.—Reference to Rule 73 omitted.

Rule 23a, par. 1.—Addition of the word "ungrounded" before "service wires."

Rule 23a, par. 2.—Changed to permit the potential coils of meters to be connected on the supply side of service fuses where service switch, service fuses and meter are combined in an approved self-contained device.

Rule 23a, par. 3.—Omitted.

Rule 23a, par. 4.—Transferred to 23*a*, par. 3.

Rule 23d, par. 3.—Addition to include receptacles for attachment plugs.

Rule 23d, par. 4.—Omitted.

Rule 23d, par. 5.—Transferred to 23*d*, par. 4, and changed to require all wires of all branch or tap circuits connected to lamp sockets or other translating devices to be protected by proper fuses.

Rule 23d, par. 5 (new).—Gives table of rated capacity of fuses protecting circuits of 660 watts or less.

Rule 23d, par. 6.—Omitted.

Rule 23d, par. 7.—Transferred to 23*d*, par. 6.

Rule 23d, par. 8.—Transferred to 23*d*, par. 7.

Rule 23e, par. 1, fine-print note.—Table changed to conform to Rule 8*c*, fine-print note after par. 4.

Rule 24a, par. 1.—The words, "and arranged to cut off the entire current," transferred to 24*a*, par. 2. Last sentence transferred to 24*a*, par. 4.

Rule 24a, par. 2.—Addition to permit the placing of meters on supply lines where service fuses and meter are combined in approved single self-contained unit device, having no exposed wiring or live parts and no parts not protected by the fuses.

Rule 24a, par. 3.—Transferred from last sentence of 24*a*, par. 2.

Rule 24a, par. 4.—Transferred from last sentence of 24*a*, par. 1.

Rule 24a, par. 5.—Transferred from 24*a*, par. 3.

Rule 24a, par. 6 (new).—Permits for three-wire, direct-current or single-phase systems with grounded neutral, the service switch to be so designed as to permit either outside wire to be opened independently of the other, provided that the neutral cannot be opened without opening both outside wires.

Rule 24c, par. 1.—Addition referring to sec. *a*.

Rule 24e.—Reworded.

Rule 25.—Title changed to read "Heating Devices."

Rule 25a, par. 1.—Addition: Subdivided circuits of heater need not be separately fused. Reference to switch or plug connector transferred to 25*a*, par. 2.

Rule 25a, par. 2.—Transferred from 25*a*, par. 1, and changed to permit approved plug connectors in lieu of switch where capacity of heater does not exceed 15 amperes or 1650 watts, and requiring switches controlling subdivided circuits of a heater not to take the place of the main switch called for.

Rule 25a, par. 3 (new).—Requires that single-pole switches on the individual units of electric ranges, etc., are not to be considered as taking the place of the switch required by 25*a*, par. 2.

Rule 25d, fine-print note (new).—Recommends that an approved signal or protective device be used with each heating device or group of devices.

Rule 25e, par. 2 (new).—Requests the grounding of stationary heaters.

Rule 26a, par. 1 (new).—Requires that after Jan. 1, 1919, neutral conductor of all three-wire circuits and one conductor of all two-wire circuits have an identifying insulating covering readily distinguishing it from other wires and properly connected to identified terminals. [This requirement has since been postponed.]

Rule 26a, par. 2 (new).—Ground connections of circuit wires must conform to Rules 15 and 15A.

Rule 26b.—Transferred from 26*a*.

Rule 26c, par. 1.—Transferred from 26*b*.

Rule 26e, par. 1.—Requirements as to running boards and guard strips reworded.

Rule 26f, par. 1 and 2.—Combined, and addition to permit the running of wires on upper edge of joists in accessible roof spaces, provided a knob is placed on each joist.

Rule 26k, l and m.—Heading changed to read, "For surface wiring raceways." Words "moulding" and "mouldings" changed to "raceway" and "raceways" throughout these three sections.

Rule 26r, par. 4.—Addition to include at meters and other places.

Rule 26t.—Addition permitting conduit and armored cable to terminate in approved fitting having a separate bushed hole for each conductor where the wires pass from conduit or cable without splice, joint or tap.

Rule 26u, par 3 (new).—Describes the method of installing outlet boxes, plates, cabinets and switch boxes.

Rule 27b, par 5 (new).—Describes method of terminating armored cable.

Rule 27c.—Grounding changed to conform to Rule 15A.

Rule 27e.—Terminal fittings not required if protection is afforded by the boxes themselves.

Rule 27f.—Addition to permit the concealing of junction boxes, if installed in accordance with Rule 26*t*.

Rule 28f.—Changed to conform to Rule 15A.

Rule 28g.—Addition to permit the concealing of junction boxes, if installed in accordance with Rule 26*t*.

Rule 28i.—Fine-print note addition after first table, permitting the installing of one more conductor than permitted by table when wire is not greater than No. 10 B. & S. gage and conduit is not longer than 30 feet and has not more than the equivalent of two quarter bends.—Twin-conductor table omitted.—First two items in single-conductor-combination table omitted.

Rule 29.—Heading changed to read, "Metal Raceways for Surface Wiring."

Rule 29a (new).—Requiring that metal raceways be used for exposed work only.

Rule 29b.—Transferred from Rule 29*a*, and "mouldings" changed to "raceways."

Rule 29c.—Transferred from 29*b* and "moulding" changed to "raceway."

Rule 29d.—Transferred from 29*c* and reworded.

Rule 29e.—Transferred from 29*d* and changed to conform to Rule 15A.

Rule 29f.—Transferred from 29*e* and "moulding" changed to "raceway."

Rule 30.—Addition in index of reference to gas-filled lamps.

Rule 30a, par. 1.—Changed and referred to items 1 to 4, inclusive, following par. 4.

Rule 30a, par. 2.—Transferred from Rule 30*a*, par. 3 and 4.

Rule 30a, par. 3.—Transferred from Rule 30*a*, par. 2, and addition to include blind hickeys.

Rule 30a, par. 4 (new).—Describes under four items when insulating joints may be omitted.

Rule 30c, par. 2.—Addition of other heat-resisting coverings.

Rule 30e, par. 2.—Addition to reference to Rule 32*e*.

Rule 31d.—Reworded and requirements of bushings set forth.

Rule 32d, par. 3.—Addition requiring guard to be securely attached to sockets or handles.

Rule 32f.—Addition of the word *approved*.

Rule 32h.—Addition, permitting the use of covers provided with a smooth, well-rounded surface on which the cord will bear.

Rule 33.—Italic subheading omitted.

Rule 35d.—Substitution of the words "other heat-resisting" in place of "asbestos."

Rule 37a (new).—Describes the installation of electrical circuits and parts of electrically operated organs.

Rule 38u.—Transferred to Rule 38A, sec. *e*.

Rule 38v.—Transferred to Rule 38A, sec. *f*.

Rule 38A (new).—Describes the installation of equipment in moving-picture factories and studios, and moving-picture equipments.

Rule 38A, sec. e.—Transferred from Rule 38*u*. Item 1 changed to require metal thickness not less that of No. 24 U. S. Sheet Metal gage.

Rule 38A, sec. f.—Transferred from Rule 38*v*.

Rule 40, sections e, f, i and j.—"Moulding" changed to "raceway."

Rule 41e, item 3 (new).—Describes method of installing cutouts.

Rule 41e, item 4 (new).—Describes construction of cabinets.

Rule 41e, item 5.—Transferred from Rule 41*e*, item 3.

Rule 42a.—First sentence changed to read, "with sufficient floor area to permit the storage of more than 2 vehicles, as above." "Mouldings" changed to "raceways."

Rule 42c.—Addition recommending the type of cord to be used.

Rule 43e.—Changed to conform to Rule 15*A*.

Rule 44a.—Changed, describing the method of installation and type of wiring required for high-potential systems, and conduit required to conform with Rule 15A and Rule 28.

Rule 44b, par 1 (new).—Describes the method of protecting metal-sheathed cable ends where exposed to moisture.

Rule 44b, par. 2 (new).—Permits the metal sheath over splices to be omitted where not exposed to moisture.

Rule 44c, par. 1 and 2.—Combined and addition describing the type of buildings.

Rule 44c, par. 3.—Omitted.

Rule 44d.—Omitted.

Rule 48.—Omitted and left blank for future use.

(*To be continued.*)

MOTOR PROBLEM WITH ARMATURE SHAFT SLIGHTLY TOO LONG.

By T. H. Reardon.

In some repair work that came under the writer's supervision recently it was found necessary to change armatures in a ¾-hp., direct-current, 110-volt motor. The motor in question was a twin in a set of two motors, the arrangement being such that in case either motor failed, the other twin stood ready to take its place, thus preventing interruption to service.

The first thing that developed in connection with changing the armature was that while one motor was driving and carrying the load all right, the damaged motor or its armature could not be removed without putting the good motor out of commission. Between the two motors and capable of engaging with either was a quill shaft carrying a worm drive on its middle portion, the worm drive being in mesh with a centrally located worm wheel that received the power delivered by either motor. The driving end of each motor shaft entered the corresponding end of the quill shaft so that one armature shaft at each end supported this middle auxiliary device. A flange coupling carrying a tooth was keyed to each armature shaft about 2 in. from its end. The quill shaft also carried two corresponding flange couplings, each flange with a ⅜-inch hole for the reception of the tooth on the driving flange with which it engaged. By using a shifter the quill shaft and its flanges could be shifted to right or left, thus disengaging from one motor and engaging with the other one. However, if the disabled motor was removed there was nothing left to hold up the end of the quill shaft at that end and therefore one good motor could continue to furnish service but it was necessary that the disabled motor should remain with it. In a later design of this same set of equipment the quill shaft is supported by two independent sets of bearings and this particular handicap is eliminated.

The second development was of a different kind The two motors were bolted down rigidly and after the new armature was placed in the field of the disabled motor it was found that the quill shaft would not slide over the armature shaft far enough to allow corresponding flanges to get together. The trouble was reported and it was suggested that the armature shaft was somewhat longer than the original one. As no linear measurements were taken and as the new shaft was where it could not be measured without disassembling, the claimed infallibility of serial numbers, specifications, etc., was introduced to show that an error in shaft length was the next thing to the impossible.

However, a machinist was sent from the mechanical department and it took just about two minutes for him to get the correct line-up on the trouble. The motor was run by its own power, he held an ordinary hacksaw against the revolving shaft until the shaft was on the point of letting go, then stopped the motor, made the finishing strokes by hand and in about five minutes everything went together all right.

The shaft was shortened just ½ inch and thereafter no further trouble of any kind was experienced with the installation.

AMONG THE CONTRACTORS.

Harry Alexander, Inc., 20 W. 34th street, New York City, has been awarded a contract for installing an electric light and power system in the steel storage building at Norfolk, Va., by the Bureau of Yards and Docks, Navy Department, Washington, D. C. The cost of this work is approximately $9700.

Carr & Schultz Electric Co., Perry & Stockton streets, Trenton, N. J., has been awarded a contract for electrical work in connection with a new one-story hospital building being erected by the city at a cost of $20,000.

In connection with the new six-story factory being erected by the Yale & Towne Manufacturing Co., Stamford, Conn., contract for electrical work has been awarded to the Fairbanks Electric Co., 438 Atlantic avenue, in that city.

The J. G. Schaff Electric Co., Chambersburg, Pa., has been given a contract for the electrical work in connection with the construction of the new addition to the local roundhouse of the Cumberland Valley Railroad, at a cost of $30,000.

The Davis Electric Co., Newark, N. J., has received a contract for the electrical work in connection with the construction of a new police station and fire house by the Kearny, N. J., Town Council.

QUESTIONS AND ANSWERS

All readers are invited to submit questions and answers to this department. Anonymous communications will not be considered. Questions should relate to electrical matters of any kind. Answers contributed by readers should be submitted preferably within eight days of the date of publication of the question and should be limited, if possible, to 300 words. Payment will be made for all answers published.

Questions.

No. 445.—Insulation of Armatures.—I want to get some information about the kind and amount of insulation to use in rewinding direct-current and alternating-current armatures. I find in books and magazines lots of data about the connections for the windings but nothing of a practical nature as to the kind of insulation that should be used in the slots. What kind of insulation should be used in slots for armatures of machines of the following voltages: 110 a.c., 110 d.c., 220 a.c., 220 d.c., 440 a.c., 500 d.c., 2200 a.c., 4400 a.c., 6600 a.c.? Is there any good practical rule by which I can know the right kind of insulation to use when rewinding a machine?—E. T. C., St. Joseph, Mo.

No. 446.—Lamp-Life Record System.—Where it is impossible to mount lamps out of reach or to employ locking sockets and etched bulbs to prevent or deter theft, what means are taken to secure record of breakage and length of time lamps remain in sockets, or electrical life? Is it practical to use corresponding socket and lamp numbers or labels?—M. K., New York City.

No. 447.—Pulling In Heavy Cable.—In pulling in some 500,000-cir. mil cables into conduit we have not been able to make a good fastening that will hold between the pulling-in rope and the cable. Will some electrician who has had considerable experience in this line of work advise through Electrical Review how such a connection can be made satisfactorily?—R. B., Kankakee, Ill.

No. 448.—What Is an Accessible Attic?—What is the real meaning of the term "accessible attic," which occurs in National Electrical Code Rule 28*g*? This rule states that junction boxes are considered accessible "when installed in an attic that has sufficient headroom but which is reached only by a portable ladder and permanent hatch." What would be deemed "sufficient headroom?" Would a space having a vertical clearance of 2½ or 3 ft. in a reinforced concrete building, space being entered by manholes located in the floor, be considered an accessible attic, and could junction and pull boxes not opening on the outside be installed in such an attic without violating the intent of the Code rule?—D. A. T., Cincinnati, Ohio.

Answers.

No. 441.—Costs of Knob and Tube, and of Molding Wiring.—A number of weeks ago there were published in Electrical Review some charts and data showing the cost of conduit wiring. This was the best information of this kind that I have ever seen. My only regret was that there was nothing included on knob-and-tube and molding wiring. If some of your correspondents can present similar information for knob-and-tube and molding wiring I am sure that the information will be greatly appreciated by your readers. —C. T. L., Toledo, Ohio.

I know of no reliable data on these kinds of wiring. Most work of this kind is done in the smaller cities, since it is coming to be the practice in the large cities to have nothing but conduit work, armored cable and the like. The work therefore is done by wiremen of various degrees of experience and is probably not so well standardized as conduit work now is coming to be. However, I know that at least one organization is anxious to compile data on this subject. It is the Electrical Estimators' Association of Chicago, of which John R. Smith, care of Freeman-Sweet Co., 608 South Dearborn street, Chicago, is secretary. This is the organization that gathered the valuable labor cost data referred to by C. T. L. If any readers have information along this line, I am sure that Mr. Smith will be glad to receive same for use by his association in working up supplementary labor data covering these kinds of wiring.—B. H. F., Chicago, Ill.

No. 442.—Drilling Steel Cabinets and Boxes.—I often get steel panel boxes in which I have to drill holes for additional conduits. This work has to be done out on the job. I have been using big twist drills, but this method is not very satisfactory and is quite expensive. Can someone suggest a better one?—M. D. B., Cedar Rapids, Iowa.

Answer A.—I have been up against the same trouble that M. D. B. is, namely, cutting conduit holes in steel panel boxes on the job. Some time ago, however, I heard of a special cutter for this work which goes by the trade name "Jiffy Cutter." It is sold by the Koch & Sandidge Co., 17 South Wells street, Chicago, Ill. I got one of these and found it to be just what I was looking for. It not only greatly reduces the amount of time necessary to cut the hole but gives me a nice clean hole when through. The outfit consists of a ratchet wrench, cutter head, two knives and a knife-holder wrench. It is possible to vary the position of the knives in the cutter head so as to cut different diameter holes. I have never had to cut larger than 3½-in. holes, but they tell me it is possible to obtain a larger size of this cutter which will cut holes up to 12 in. in diameter.—P. S. J., Pittsburgh, Pa.

Answer B.—The writer would suggest that M. D. B. secure one of the rotary expanding hacksaw equipments that recently were on the market by Barnes & Irving, Syracuse, N. Y. They consist of a shank to fit a bit brace carrying a large disk with a drill or pilot in the center. In the face of the disk a number of circular grooves are cut with various diameters. Hacksaw blades are bent and placed in the groove corresponding to the diameter desired and the apparatus is ready for use.—A. A. N., Ampere, N. J.

No. 443.—Location of Service Switches.—The Underwriters' rule states that the service switch must be placed in the nearest readily accessible place to the point where the wires enter the building, which I interpret to mean that a separate switch is required for every building. I recently wired a new building, however, in which it was very difficult to decide how to locate the switch. The building was three stories high with stores on the first floor, offices and an apartment on the second, and a large apartment on the third floor. The entire building had a frontage of 125 ft., which was divided into three sections. Each of these sections was separated from the others by a fire wall and constituted a building in itself, having separate heating plants, chimneys, etc., with no interior pasageways between the sections. The entire building was erected on one building permit and had but one sewer and water connection. I finally decided to install a separate switch and outlet for each section, in order to be on the safe side, although it cost more to do so, but for future reference I would like to know whether I was correct or not.—L. M. C., Baltimore, Md.

Answer A.—The usual requirements are one fused main-line switch for each service. The Underwriters' maximum ruling in your case would probably be that each section be fused only. "In risks having private plants the wires running from building to building are not considered as service wires, so that cutouts would not be required where the wires enter the buildings, provided that the next fuse back is small enough to properly protect wires inside the building in question." This rule (*23a*) applies to isolated plants in industrial works, but where the service is supplied from a central station, I have known the ruling to be modified by the insertion of fuses only in each building or section, and same has been approved by local boards for any building having separate fire sections.—M. K., Passaic, N. J.

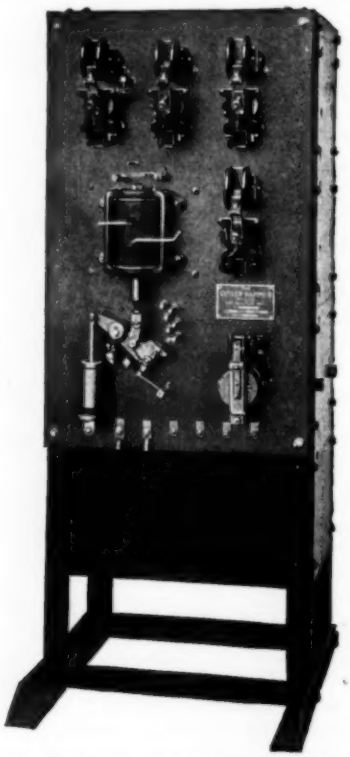
[Other answers to Nos. 442 and 443, and one or more to 444 will appear in an early issue.—Ed.]

New Appliances

Magnetic Motor Starter—Time-Limit Overload Fuse Plugs —Test Links for Signal Circuits—New Grounding Device

MINE-DUTY MOTOR STARTERS.

On account of the injurious effects of moisture present in mines and the severe operating conditions, special care should be used in the selection of motor starters and controllers, particularly the starters and controllers for the ventilating fan and pump motors, as in most mines these two pieces of apparatus must be kept in continuous operation to free the mine of water and dangerous gases. Another condition which affects the operation of motor starters is the wide fluctuations in generator or line voltage caused by mine hoists and locomotives. For these reasons the standard design of hand or automatic starters will not operate satisfactorily and a starter should be selected



Magnetic Switch Type of Mine-Duty Motor Starter.

which is especially adapted to operate under such conditions.

The accompanying illustration shows a mine-duty self starter, manufactured by the Cutler-Hammer Manufacturing Co., of Milwaukee, Wis., which has recently been redesigned and which embodies several operating and protective features essential to the continuous operation of a ventilating fan or pump motor.

Plain hand starters and starters without self-resetting features will drop to the "off" position every time a large drop in voltage occurs; this, of course, stops the motors controlled by them and serious results may follow. When a motor receives current at a voltage considerably lower than its rated potential it will slow down, and stop when this voltage drops to a certain value or when the current is "off." Control apparatus is required that will automatically insure the continuous running of the pumps and fans, even if at reduced speeds, and will also restart them after a complete interruption and subsequent resumption of current supply.

To meet these conditions the starter illustrated, which is a pilot-switch accelerator type for motors up to 100 hp., is equipped with a rugged relay which is very sensitive and positive in its action. This relay guards against injury to the motor; it causes all of the armature resistance to be inserted in case of a bad drop in voltage, thus checking the heavy current resulting from the decreasing counter electromotive force. If the line pressure falls to about 80% of normal the relay drops out, opening the control circuits to the accelerating switches, which drop in turn and cut into circuit the heavy-duty starting resistance, which has capacity for continuous service at low voltage. The motor then runs at slow speed until the voltage increases and at about 90% of normal the relay pulls in again, cutting out the resistance and permitting the motor to accelerate to normal full speed.

A single-coil overload, where shunt-wound motors are used, can be added to also insert the armature resistance in case of an overload and thus keep the fan or pump going at a reduced speed. This single-coil overload and the voltage relay prevent the shunt motor from flashing over under severe voltage fluctuations. When the voltage drops to a very low value the motor tends to run as a generator and is liable to flash over across the brushes, injuring the motor and commutator With a compound motor the overload is not so necessary, because when the motor tends to run as a generator the compound winding opposes the shunt winding, neutralizing the field and preventing those conditions which result in flashing over.

TIME-LIMIT OVERLOAD PROTECTIVE PLUGS FOR MOTOR SWITCH.

The type CR-1038 switch as manufactured by the General Electric Co., Schenectady, N. Y., designed for connecting alternating-current motors up to 3 hp., 110 volts, and 5 hp., 220, 440 and 550 volts, direct on the line, contains a feature other than the quick-make-and-break switch which will no doubt be of interest, and this is the time-limit overload protective plugs. These plugs are located immediately below the switch proper and inside the sheet-iron case covering the whole device.

These protective plugs contain, as shown in Fig. 2, a stationary contact post with heating coil *A* and a fusable link *B*, which binds a spring contact arm to the stationary post. The motor circuit is completed through the heating coil, post, link and spring contact arm. In

case of an overload, the current passing through the heat coil will heat the post sufficiently to melt the low-fusible alloy that holds the link together, thus releasing the spring contact arm and causing it to take the

Fig. 1.—Motor Switch Opened to Show Barriers and Fuse Plugs.

position as shown by the dotted line *D*, thereby opening the circuit between the contact arm and the post.

These fusible links, which cost but very little, are easily renewed by simply slipping the link down over the end of the post and fastening the spring contact

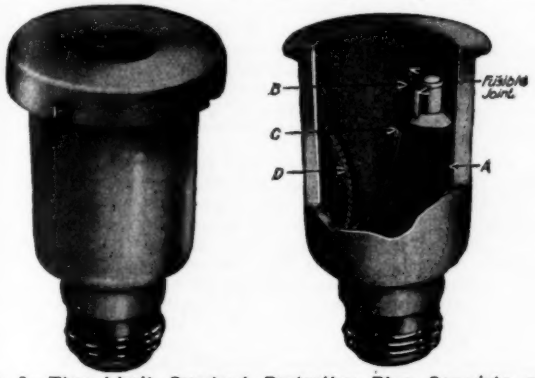


Fig. 2.—Time-Limit Overload Protective Plug Complete and Opened to Show Interior.

arm under at the same time, see Fig. 3. The successful operation of the protective plug depends upon the special low fusing alloy which holds the link together, and only the new links manufactured by the General Electric Co. should be used with these plugs.

By reason of the time-lag feature, the momentary

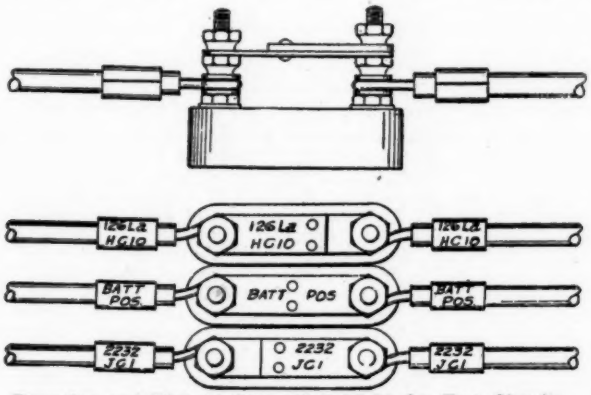
Fig. 3.—Removing Protective Plug Easily and Safely.

inrush starting current will not cause the plug to open the circuit. The plugs protect the motor from any conditions of overload that, if maintained for a sufficiently long period, would overheat the motor. Such conditions include the following: Polyphase motors running single-phase; motors stalled and an attempt made to start them; motors called upon to drive too heavy a load. In any of these or similar cases the plugs will open the circuit in time to save the motor.

CONTROLLING AND DESIGNATING TEST CIRCUITS.

In testing out the circuits used for railway signaling, as well as in many other classes of work, much time is lost in rupturing and in again closing the circuits, as also in determining which the circuits are. Moreover, where circuit terminals are mounted close to each other, it is often difficult to get at any one link for detaching the same when the circuit controlled by it is to be opened.

To overcome these difficulties, Jerome M. Carley, of East Greenbush, N. Y., according to U. S. Patent No. 1,281,288 recently granted to him, uses connecting links which are biased upwards, so that each link will tend to raise off its post when loosed at one end. Then he punches this end of the link larger than the shank of the binding post and bushes it by means of an in-



Elevation and Plan of Connecting Links for Test Circuits.

sulating piece riveted to the top of the link. Consequently, the mere loosening of a nut (as shown in the upper part of our illustration) opens the circuit without entirely detaching any part, and a tightening of the nut instantly closes the circuit again. What is more, the insulation strips may easily be stamped to designate the particular circuit.

NEW PARAGON GROUNDING DEVICE.

The importance of grounding electrical circuits is steadily increasing, as is shown by the considerable space given to it in the revised edition of the National Electrical Code, in which Rules 15 and 15A deal with this subject exclusively. This calls attention to an improvement in the grounding device long known on the market as the "Paragon Ground Cone."

The new type of the device is made in cylinder form. The cylinder is made of heavy rolled sheet copper and is not perforated except at the ends; either one or both ends may be perforated. The interior is filled with pea-sized charcoal if it is important to have increased hygroscopic properties. If the latter are not necessary, the cylinder may be left unfilled. In each type of the Paragon device 5 ft. of No. 4 soft copper leading-in wire is solidly welded to the cone or cylinder, thus making it possible to connect with the ground wire without danger of having a poor connection with the grounding device itself. These devices are manufactured by the Paragon Electric Co., Chicago, Ill.

Trade Activities

New Construction and Engineering Firm Formed by D. P. Robinson — Westinghouse Electric Closes Five Plants

Electric Storage Battery Co., Philadelphia, has issued new editions of several sectional catalogs. Section MS deals with miscellaneous types of the "Exide" battery for automobile starting and lighting service; Section SLI covers "Exide" batteries for starting, lighting and ignition service; Section SLP lists parts of batteries; in Section V various types of batteries for electric vehicles are described, while Section AB deals with the "Chloride Accumulator" and "Tudor Accumulator" and parts and accessories.

Link-Belt Company, with main offices at Chicago, has issued a very interesting book on the important subject of "Economical Handling of Coal and Ashes and Reserve Coal Storage." This book, of 52 pages, covers very fully the economical handling of coal and ashes in utility and industrial plants. Numerous halftones and line drawings are included showing a number of power plants, coal weighing apparatus, coal handling equipment and many types of coal bunkers. Some cost data is also given. Coal and ash handling and the storage of coal are discussed in a thorough manner. This book is a valuable contribution to the subject and is recommended to all operating engineers.

W. E. Davis Advertising Service, Plymouth building, Minneapolis, announces that hereafter it will be known as Davis & Armstrong, Inc., a change occasioned by the consolidation of the Armstrong Advertising Service of Minneapolis and the W. E. Davis Advertising Service, under the new name. The new firm will occupy the offices formerly used by the W. E. Davis Advertising Service in the Plymouth building. This new arrangement gives the advertising concern the services of J. C. Armstrong, an experienced and capable advertising man, and places it in a better position to serve and co-operate with its clients, publishers and others whom it serves.

American Technical Society, Chicago, has recently issued a pamphlet of practical reference libraries in which is listed the Encyclopedia of Applied Electricity. This library covers thoroughly the entire field of electrical science, presenting the subject in a very concise and clear form. It covers thoroughly the elementary principles of electricity, contains a vast amount of information on every detail of each special branch, and gives all necessary tables and formulas in a simple, untechnical form. It reveals to the general reader, student and the electrical engineer alike, the discoveries of the greatest experimenters and the valuable kinks of the modern practicing expert. This library comprises seven volumes, each 7x10 in. in size, and bound in half morocco. Volume I discusses the Elements of Electricity; Vol. II deals with Dynamo-Electric Machinery; Vol. III, Direct-Current Motors; Vol. IV, Alternating-Current Machinery; Vol. V, Power Transmission; Vol. VI, Power Stations, and Vol VII, Modern Land Telegraphy.

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., following the cancellation by the Government of large contracts for shells of various sizes, has issued notice that its five plants engaged in this manufacture, as follows, will be closed immediately. The order affects a total of 8700 employes. The plants to be closed are: Garrison way, manufacturing six-inch shells for the British Government, employing 2200 persons; Twenty-eighth street works, producing eight-inch shells for the United States Government, employing 500 hands; Shadyside plant, manufacturing six-inch shells for the United States and British Governments, with 600 persons employed; Twenty-fourth street plant, engaging on the production of rifles, grenades and discharges for the United States Government, employing 400 persons; and the A. B. works of the company at East Pittsburgh, manufacturing shells for the different allied nations, employing a total of 5000 hands. The company has recently presented to the city a deed of dedication of the property formerly owned and occupied for residence purposes by the late George Westinghouse in Homewood.

Standard Brass & Bronze Manufacturing Co., Pittsburgh, Pa., manufacturer of lighting fixtures, has opened a new showroom at 636 Penn avenue, Pittsburgh, where the entire eight floors will be given over to the manufacture and display of these fixtures.

National Pole Co., Escanaba, Mich., has acquired about 5 acres of property, under a 10-year lease, on the Parr-McCormick tract, at Orland, Cal., and plans for the establishment of a plant for the manufacture of telephone and electric poles have been prepared by the company. The proposed works will adjoin the plant of the American Manganese Steel Co. The National Pole Co. also operates plants at Everett, Wash., and Duluth, Minn.

Electrical Appliance Manufacturing Corporation, Newark, N. J., has completed arrangements for the purchase of the plant recently constructed by the Diehl Manufacturing Co. at 820-50 Frelinghuysen avenue. The plant is a four-story structure, with a site of about 6 acres, and comprises a manufacturing area of about 110,000 sq. ft. The consideration was about $500,000. The Electric Appliance company is planning to take immediate possession and plans for the installation of equipment for the manufacture of electrical specialties.

Announcement is made that on and after Jan. 1, 1919, **Sanford Riley Stoker Co.** and **Murphy Iron Works** will combine their sales policies so as to render the greatest possible service to all customers. Offices will be located at Worcester, Boston, New York, Philadelphia, Pittsburgh, Buffalo, Cleveland, Detroit, Cincinnati, Chicago, St. Paul. Each office will handle both the sales and service for the Riley underfeed stoker and the Murphy automatic furnace. The engineers at the various offices will not only help customers to select the equipment most suitable for their conditions or requirements but will also be at their service at all times to show them how to get the most out of their present equipment.

Trumbull Electric Manufacturing Co., Plainville, Conn., in a ten-page pamphlet recently issued describes and illustrates "Circle T" "Safety Service" switches. These are externally operated and among the advantages claimed for this switch are that it eliminates the fire hazard; minimizes the danger from electric shock; it is very convenient, saves time and trouble, not requiring a specialist to open and close switch or new fuses; can be installed in places where it would not be safe to place an open switch and where an ordinary switch would not be convenient, and its inexpensiveness, the difference in cost being more than saved in convenience and safety.

Following a recent meeting of the directors of the **Fairbanks, Morse & Co.,** Chicago, several new and important changes in its management were announced by C. H. Morse, Jr., president of the company. One of these was the election of R. H. Morse as vice-president, in general charge of purchasing and traffic. Mr. Morse's connection with the company covers many years of varied experience in both manufacturing and sales departments, and he continues his duties as director of the firm. C. W. Pank, who has served as general director of sales, has been promoted to vice-president in charge of sales of all factory products. Mr. Pank became connected with the company 33 years ago as a stenographer and his activities through this period include every branch of sales and affiliated effort. W. S. Hovey, formerly general manager of the large manufacturing plant of Fairbanks, Morse & Co. at Beloit, Wis., has been elected vice-president in charge of general manufacturing at all factories. Mr. Hovey has been with this concern for a number of years, aiding in its development through the application of modern principles of design and manufacture to many of the Fairbanks-Morse products. W. E. Miller, first vice-president, is now vice-president and treasurer, while F. M. Boughey retires from the position of treasurer to become secretary and comptroller.

Cutler-Hammer Manufacturing Co., of Milwaukee, is distributing a novel two-page, two-color envelope folder which illustrates and enumerates the advantages of the C-H 91-16 starting switch for alternating current squirrel-cage motors. This enclosed motor starting switch, which has been previously illustrated and described in the pages of ELECTRICAL REVIEW, has a steel case which entirely encloses the mechanism and fuses with only the operating handle extending through and is so constructed that the operator cannot come in contact with any live parts. The switch is automatically locked in the open position when the fuses are exposed and the fuses are made dead. These starting switches may be operated by an unskilled worker and safety stop buttons may be placed at various locations so that in case of a dangerous machine the operator or others may push one of these buttons and bring the machine to rest, should an accident occur. The folder gives all necessary dimensions for installation and the ratings for use with standard as well as high torque motors.

Paragon Electric Co., Chicago, has issued a valuable little booklet entitled "Grounding Facts." This publication covers grounding in a thorough manner, discussing the many phases of the subject. Some of the topics covered are those dealing with permanent protection, new approved Paragon grounds, necessary and inexpensive protection, the superiority of Paragon grounds as compared with grounds formerly recommended by engineers is pointed out. The protection of telephone systems includes the discussion of grounding main-frames for lighting arresters, grounding selective ringing systems, pole cable terminals, toll-line lighting arresters, grounding telephone train despatching circuits. Telegraph systems and the various applications of grounding are discussed, as are also railway signal installations, covering grounding of transformers for alternating current signal systems, grounding lighting arresters on direct-current signal systems. Grounding for lighting and power plants is gone into in detail. This phase of the matter includes the grounding for lighting arresters for arc circuits, trolley circuits, power and light circuits, grounding transformer secondaries and of neutrals and protection of station equipment. Rules for transformer installations, as based on the National Board of Fire Underwriters' Code, are aso included; specific instructions are given for installing Paragon grounds. The pamphlet is illustrated with some 20 odd illustrations, and represents a concise discussion of the important and wide subject of efficient and permanent grounding.

Dwight P. Robinson Forms New Construction and Engineering Firm.—An interesting and important addition has been made to the ranks of construction and engineering organizations in this country by the formation of Dwight P. Robinson & Co., Inc., which has opened offices at 61 Broadway, New York. At the head of this organization, which is at once qualified to handle large and difficult undertakings, is Dwight P. Robinson, who has for 25 years been associated with Stone & Webster in the management of their electric railway and lighting properties, as president of the construction and engineering branch of their organization, and since 1912 as a member of the firm. In this capacity all of Stone & Webster's construction and engineering activities have come under his personal supervision, some of the more generally known projects being the extensive water power developments serving the Puget Sound cities, the steam and water power plants supplying Minneapolis, the electrical and transmission features of Keokuk development on the Mississippi, the Big Creek development serving Los Angeles and others in various parts of the East and South; large steam power stations for Buffalo, Boston, Minneapolis, New Bedford, Youngstown, and other smaller plants aggregating over half a million kilowatts capacity, a wide range of industrial buildings from simple warehouses and factories to monumental structures such as the new home of Massachusetts Institute of Technology; housing developments including complete towns with paving, sidewalks and all utilities.

He will have associated with him many of the men by whom he has been surrounded for years. R. M. Henderson will for the present have charge of construction. Of 12 years in the Stone & Webster organization, seven were spent as assistant construction manager at Boston, and three as district manager at Chicago. His earlier experience as industrial engineer on the staff of the Arnold Co., Chicago, and as electrical engineer of the Mexican Central Railway, was in both design and construction of railway locomotive and car shop plants and other industrial plants including such projects as the principal shops of the Mexican Central Railway at Aguascalientes, the Big Four Railway shops at Beech Grove, Indiana, and the Missouri-Pacific Railway at Sedalia. He was chiefly instrumental in the internal development of the construction department of Stone & Webster, and later had direct charge of a wide range of steam, hydraulic, industrial and building construction, including reinforced concrete structures of many types. He is 39 years old and a graduate of Armour Institute of Technology.

C. W. E. Clarke, for seven years with Stone & Webster, five of which were as mechanical engineer and head of the division, has had a long and varied experience in the design of central power stations and mechanical engineering in industrial plants. Some of his earlier work was as steam engineer of electric zone, New York Central Railroad; designing engineer, Armour & Co., Chicago; and assistant to chief engineer, Sargent & Lundy, Chicago. He has been intimately connected with or responsible for such stations as the new steam plant of the Buffalo General Electric Co.; South Boston plant of Boston Elevated Railway; the new plant of the New Bedford Gas & Edison Light Co.; Lowellville plant of the Republic Railway & Light Co.; Fisk street plant of the Commonwealth Edison Co., Chicago; Yonkers plant of Electric Zone, New York Central Railroad, and more than thirty others of various capacities, totaling many hundred thousand kilowatts.

D. L. Galusha has been working under Mr. Robinson's direction for 12 years, the past five as head of the electrical division, his experience also covering a long list of power stations and industrial plants in all sections of the country. Some of his best known work was as electrical engineer in charge of the Mississippi River Power development at Keokuk and the Minneapolis General Electric Co.'s large steam station, replacing one destroyed by fire and which was built in less than four months, although it involved extensive changes in the system of distribution and control through substations, overhead high tension, and underground systems. His experience has also included design, construction and operation of hydroelectric stations, substations, transmission lines, motor applications, lighting and power in industrial plants, and apprentice and test work in the Westinghouse Electric & Manufacturing Co. He is 37 years old and a graduate of Massachusetts Institute of Technology.

M. E. Thomas, who will have charge of structural design, has been in a similar capacity of Stone & Webster for nine years. His work has covered the layout and design of industrial factories and plants including the buildings and the structural features of steam and hydroelectric plants. He is especially able in reinforced concrete design, and with C. E. Nichols is a co-outhor of "Reinforced Concrete Design Tables." Some of the noteworthy concrete structures which have come under his direction are the monumental superstructure of the power station surmounting the dam on the Mississippi river at Keokuk, the concrete structural work of the new buildings of the Massachusetts Institute of Technology, the wonderfully fine concrete buildings of the Field & Siege Gun Carriage Plant at Rock Island Arsenal, and the less pretentious but larger brick and steep group at Watertown Arsenal. The numerous steel unit warehouse buildings and shop buildings which were fabricated in America and shipped to France for the American Ordnance Base Depots back of the fighting line were designed by Mr. Thomas. He is 35 years old and a graduate of the University of Illinois.

R. A. Philip's association with Mr. Robinson began 18 years ago as electrical engineer of the Seattle Electric Co., which was then under the management of Mr. Robinson. This association has continued without interruption so that Mr. Philip has had an intimate connection with all of Mr. Robinson's important activities mentioned above. His special field is that of consultant on electrical engineering matters, reports, estimates, and appraisals of electric utilities and power properties. His earlier experience was as assistant to the city electrician, Tacoma, Wash., and with the General Electric Co. He is 44 years old and a graduate of Rose Polytechnic Institute.

War work at various arsenals, cantonments, ordnance bases, and on other direct and indirect war plants in this country and France, has occupied these men from the beginning of the war until the needs of such work has passed. They form the nucleus of an extensive staff whose development will keep pace with the activity of the reconstruction period. Adequate financial resources and connections assure the company's ability to handle operations of any magnitude.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

BOSTON, MASS.—Linde Air Products Co. is rushing to completion the construction of its new plant and power house on First street. It is planned to inaugurate operations at an early date.

EAST PROVIDENCE, R. I.—American Electric Works, Phillipsdale, is having plans prepared for the erection of a pumping plant at its local works. The structure will be one-story, about 20x20 feet, and a new centrifugal pumping unit will be installed.

LITCHFIELD, CONN.—Trumbull Vanderpool Electric Manufacturing Co. has commenced the construction of a two-story factory addition to its plant in the Bantam section. The structure will be about 40x80 ft., and is estimated to cost $20,000.

BINGHAMTON, N. Y.—Friends in the Common Council of a municipal lighting plant have renewed the movement to construct one. In obedience with a resolution offered by Alderman Quinn the president appointed a committee of five to investigate the advisability of proceeding with the construction of such a plant. The resolution asserts that the council has been unable to procure a renewal at reasonable rates of the contract with the Binghamton Light, Heat & Power Co.

BUFFALO, N. Y.—Monarch Knitting Co., Inc., 19 Doat street, has completed final arrangements for the construction of the proposed boiler plant at its works on Rustic place. In connection with another structure to be erected at the plant, the work is estimated to cost $22,000. R. E. Williams, Iroquois building, is the contractor.

MARINERS HARBOR, S. I., N. Y.—Staten Island Shipbuilding Co. has awarded a contract to the Fred T. Ley Co., 19 West 44th street, New York, for the erection of a one-story boiler plant, about 30x90 feet, estimated to cost $10,000. Lockwood, Greene & Co., 101 Park avenue, New York, are engineers for the company.

REDFIELD, N. Y.—Not only is the Salmon River Power Co. to raise the crest of its dam in Redfield 10 ft., but the company is preparing to build another complete hydroelectric plant, including a dam, power house and pipe line near Altmar. C. E. Briggs of Daysville and a force of 20 or more men, consisting of engineers, roadmen, mechanics and laborers, have started surveying above and below Altmar. Address Dexter P. Cooper, general supervisor of the work.

WATERTOWN, N. Y.—A power plant costing $500,000 will be erected on Beebee Island. The following companies are interested in the construction of the plant: Knowlton Brothers, Inc., New York Air Brake Co., J. B. Wise, Inc., Northern New York Utilities, Inc., George A. Lance, A. G. Herrick & Son. Samuel M. Green Co., hydraulic engineer and contractor of Springfield, Mass., has submitted plans and estimates.

AMPERE, N. J.—Crocker-Wheeler Co., manufacturer of motors, generators, etc., is planning to increase its working force. It is understood that about 50 men will be added.

JERSEY CITY, N. J.—In connection with the proposed issuance of bonds for $4,000,000 to be used for various purposes, an appropriation has been arranged for $198,000 to provide for the construction of a new administration annex and power plant at the Lincoln High School; and it is proposed to appropriate sums for the installation of new boiler equipment at the City Hospital and the installation of boiler equipment at the Coles street Bath House.

NEW BRUNSWICK, N. J.—Board of Commissioners has awarded a contract to John L. Snitzler, 77 Cuilden street, New Brunswick, for the construction of the proposed extension to the boiler plant at Weston's Mill Pond for increased capacity.

PATERSON, N. J.—It is alleged by the Finance Committee that the Public Service Corporation under its lighting contract with the city, has been furnishing lamps of smaller lighting capacity than called for in the contract, approximating an excess charge per year of $4,000, and that a refund of about $24,000 should be made by the company.

TRENTON, N. J.—Westinghouse Lamp Co. is planning to increase the capacity of its local plant. It is understood that a large number of additional employes will be required.

TRENTON, N. J.—The Board of Taxes & Assessment during the present year has levied taxes on public utilities in the state aggregating about $2,200,000, covering the properties of the Public Service Corporation, the New Jersey Power & Light Co., the Atlantic Coast Electric Light Co., the Freehold Gas Light Co., the Lambertville Public Service Co., and other large and small organizations. The amount of taxation for the respective corporations is, electric and gas, $921,637; street railway, $911,289; telephone and telegraph, $298,127; water, etc., makes up the remainder.

BUTLER, PA.—Imbrie Coal Co. has commenced the construction of the proposed one-story power plant, about 40x65 ft. The structure, which is estimated to cost $10,000, will be located at Nichola, Pa.

CARLISLE, PA.—Western Union Telegraph Co. has completed plans for the installation of an underground conduit system to replace the present overhead wires.

FRANKLIN, PA.—Chicago Pneumatic Tool Co. has completed plans for the construction of a new one-story brick and steel assembling plant addition to its local works, estimated to cost $50,000.

NEWCASTLE, PA.—Newcastle Electric Service Co. has recently placed into effect increased rates for its service

NICETOWN, PA.—Midvale Steel & Ordnance Corporation, Widener building, Philadelphia, has had plans prepared for the installation of new reinforced concrete oil and switch cells at its local works (specification 26958).

PHILADELPHIA, PA.—The board of directors of the Philadelphia Electric Co. has authorized the issuance of stock for $4,997,550, to provide for general expansion and the betterment of its service. Included in the improvement program is the extension of its plant at Chester, which operates a 30,000 kw. unit at the present time. It is proposed to place into operation another unit of similar capacity for furnishing service to the plant of the American International Shipbuilding Corporation, Hog Island, and other industrial establishments in the Eddystone section.

PHILADELPHIA, PA.—Fire on Nov. 17, caused by an explosion in the compressed air system in section A at the plant of the Baldwin Locomotive Works at Eddystone, damaged the plant to the extent of approximately $25,000.

PHILADELPHIA, PA.—Barrett Manufacturing Co., 36th street and Gray's Ferry Road, has awarded a contract to Charles Colgan, 2065 South Salford street, for the erection of an addition to its power plant. The structure will be one-story, brick and concrete, about 38x44 ft., and will cost $6,750.

PITTSBURGH, PA.—Fire, on Nov. 26, destroyed a large quantity of electrical equipment, machinery, etc., at the Crescent plant of the Crucible Steel Co. The fire, which was caused by an explosion, caused a loss of approximately $75,000, of which $50,000 was in machinery, and $25,000 in buildings.

PITTSBURGH, PA.—Electric Appliance Co. has filed notice of an increase in its capitalization from $25,000 to $40,000, to provide for expansion at its plant.

SCOTDALE, PA.—Electric Water Sterilizer & Ozone Co. has filed notice of an increase in its capital from $250,000 to $350,000, to provide for general expansion.

STATE COLLEGE, PA.—Fire on Nov. 25, completely destroyed the engineering school building with equipment at the Pennsylvania State College. In this connection the heat, light and power plant has also been considerably damaged. The total loss is placed at approximately $300,000.

ELKTON, MD.—A. J. Reach Co., Philadelphia, Pa., has completed arrangements for the erection of a one-story boiler plant, about 18x35 ft., at its local works. The structure is estimated to cost $6,000. John E. Healy & Sons, Inc., 707 Tatnall street, Wilmington, Del., is the contractor.

WASHINGTON, D. C.—Washington Railway & Electric Co. is going ahead on its plans to construct a stretch of track on 17th street from H street to Pennsylvania avenue, northwest. The United States Housing Corporation has announced its intention of financing the project. President William F. Ham, of the railway company, asked that the amount of bonds to be issued be raised from the original $125,000 to $150,000. It is understood that the housing corporation will agree to the increased amount.

NORFOLK, VA.—Chesapeake & Potomac Telegraph Co. is erecting an exchange. The equipment is not yet purchased. Address C. F. Ronney, superintendent of the telegraph company.

CLARKSBURG, W. VA.—Clarksburg Light & Heat Co. has filed application with the Public Service Commission for permission to increase its rates for service.

HOLDEN, W. VA.—Island Creek Coal Co. is planning for the installation of two large new boilers in its power plant, to provide for increased capacity. A. R. Beisel is general manager.

NEWTON, W. VA.—In connection with the construction of the proposed new plant of the Manganese Steel Casting Co., estimated to cost in the neighborhood of $300,000. The plant will include the erection of a large power plant for operation and the installation of four 10-ton electric furnaces.

WHEELING, W. VA.—Wheeling Electric Co. is said to have completed arrangements for the construction of a large steam power plant to be located at Windsor, estimated to cost in excess of $1,500,000. The Foundation Co., New York, is the contractor.

WINDSOR, W. VA.—West Penn Power Co., Pittsburgh, Pa., is planning to place in operation at its local plant a 30,000-kw. unit, to provide for increased capacity, the installation to be completed by the first of the year. It is also proposed to install another unit of similar capacity, to be ready for operation by about the first of March.

BAKERS, N. C.—The Government, Bureau of Yards and Docks, has had plans prepared for the erection of 20 new radial towers in connection with the construction of the proposed new local radio station.

NORTH CAMP JACKSON, S. C.—The Government has recently issued notice that the construction of a new radio school and radio buildings at the local military camp has been discontinued.

DATES AHEAD.

Electrical Supply Jobbers' Association. Semi-annual meeting, Cleveland, Ohio, Dec. 9, 10 and 11. General secretary, Franklin Overbagh, 411 S. Clinton street, Chicago.

Florida Engineering Society. Annual meeting, Jacksonville, Jan. 5, 1919. Secretary, J. R. Benton, Gainesville, Fla.

American Institute of Consulting Engineers, Inc. Annual meeting, New York City, Jan. 13, 1919. Deputy secretary, B. Etchelle, 35 Nassau street, New York City.

Northern White Cedar Association. Annual meeting, Milwaukee, Wis., Jan. 21, 1919. Secretary, N. E. Boucher, 702 Lumber Exchange, Minneapolis, Minn.

Western Association of Electrical Inspectors. Annual meeting, Chicago, Ill., Jan. 28-30, 1919. Secretary, W. S. Boyd, 175 West Jackson boulevard, Chicago, Ill.

Oklahoma Utilities Association. Annual meeting, Oklahoma City, Okla., Feb. 13, 14 and 15. Secretary, H. A. Lane, Oklahoma City, Okla.

New Mexico Electrical Association. Annual meeting, Albuquerque, N. Mex., Feb. 17-19. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. Mex.

SOUTH JACKSONVILLE, FLA.—The city is considering plans for the erection of a new addition to the municipal power plant, to provide for increased capacity.

NORTH CENTRAL STATES.

LORAIN, OHIO.—The citizens have petitioned for better lighting. Address W. A. Pillans, city director.

MASSILLON, OHIO.—Republic Construction Co. has the general contract for an addition to the power plant of the Massillon Gas & Electric Co.

MOUNT STERLING, OHIO.—George W. Tanner, village clerk, will receive bids until noon, Dec. 16, for $10,000 water and light bonds.

NILES, OHIO.—Angel Aircraft Co. has asked the council to pass an ordinance to have a heavy wire from the city plant extended down Water street as far as the corner of Pratt street and East Park avenue. The Angel company, with other manufacturing plants on the east side, will then be able to get more power and take the burden from the wires used by the citizens. The Angel plant uses one-half as much current as the whole city. The cost is estimated at $7,000.

RICHMOND, IND.—The city council has appointed Edward H. Harris, Edward Cureton and Walter V. Reid as a special committee of citizens to act with a committee of members of the council to investigate the needs of the Richmond municipal electric light and power plant. The increasing demands on the plant, both in the light and power departments has, in the judgment of the management of the plant, made necessary extensive new equipment and with this additional cost to be carried it has been proposed that the city petition the Indiana Public Service Commission for an increase in rates. The municipal plant in Richmond has been one of the most efficient in the state of Indiana and has furnished excellent service at lower rates than are charged by the most of Indiana municipalities.

OTTAWA, ILL.—The city of Ottawa and certain citizens of that city have joined in a petition asking that the Illinois Public Utilities Commission issue an order to restore service by the Northern Illinois Light & Traction Co. in that part of the city north of the Chicago, Rock Island & Pacific railroad.

SPRINGFIELD, ILL.—The city of Springfield, by action of the City Commission, has taken steps to lay before James A. Garfield, national fuel administrator, its side of the proposition suggested by the state fuel administrator to have the plants of the Springfield Gas & Electric Co. and the city combined. The City Commission will seek to prove that the actual saving of coal as a result of the merger would be small and that the city would loose in revenue about $3,000 a month.

MARSHFIELD, MO.—Election to vote bonds for $15,000 for establishing an electric lighting plant, carried.

SLATER, MO.—Plans are soon to be made for electrical improvements to cost $25,000. J. A. Stern, city clerk.

ABILENE, KANS.—Riverside Light, Power & Gas Co. has purchased the property of the Kaw Valley Transmission Co. of St. George, in Pottawatomie county, which serves the town and about 40 rural homes. These will now get their power from Abilene and Rocky Ford plants. Other extensions are also being completed to Louisville, Westmoreland, and Waubaunsee county.

SIOUX FALLS, S. DAK.—Work has been started on a $125,000 addition to the Morrell Packing Co.'s plant.

SIOUX FALLS, S. DAK.—New power business connected to the lines of the Sioux Falls division of Northern States Power Co. includes 133 hp. in motors for the new Schirver-Johnson department store.

SOUTH CENTRAL STATES.

LOUISVILLE, KY.—Commercial department of the Louisville Gas & Electric Co. during the week ended Nov. 15 accepted 34 new electric light and power customers with 14 kw. of lighting and 40 hp. in motors. New business connected shows a net gain of 40 customers with 17 kw. of lighting and 144 hp. in motors. Output of electrical energy shows a gain of 11.7 per cent over the corresponding week last year.

ATTALLA, ALA.—Fire, which caused a total damage of $30,000, recently destroyed the local administration building of the Alabama Power Co.

FORT SMITH, ARK.—Coal District Power Co., which receives its requirements of electrical energy from the Fort Smith Light & Traction Co., has completed an installation of a substation for supplying the requirements of the Central Coal & Coke Co. at Hartford, Ark. The initial connected load was 400 kw. and 400 kw. additional will be connected within the next 30 days. The monthly consumption will exceed 200,000 kw-hr.

ADA, OKLA.—Oklahoma Power & Transmission Co. has completed the first unit of the large plant at Byng, six miles north of Ada. This plant will soon be completed and will light many towns in this district and provide current for many industries.

SAPULPA, OKLA.—Schram Glass Co. is installing a 150-hp. motor for the operation of its plant, replacing a 60-hp. motor. Energy for this installation will be supplied by the Sapulpa Electric Co.

BRYAN, TEX.—Bryan & Central Texas Interurban Railway Co. has resumed the operation of its line which runs from Bryan down the valley of the Brazos river for 22 miles. This line has been suspended for several weeks.

DALLAS, TEX.—Nine hundred new street lights will be installed at various places all over the city of Dallas in a very short time. Work on extending the line preparatory to installing the lights has already begun.

DALLAS, TEX.—It is stated by M. N. Baker, public utility supervisor of Dallas, that immediate steps will be taken by the city commission for the carrying out of the provisions of the new franchise granted the Dallas Railway Co. for the making of important improvements and extensions of its street railway system and the construction of interurban lines. The improvements that are called for to the street railway system will involve an expenditure of nearly $500,000. Under the franchise the company must start the construction of two interurban railways, each to be not less than 30 miles in length, and make other expenditures amounting to $1,000,000. The carrying out of these provisions of the franchise were deferred on account of the war.

HOUSTON, TEX.—The city will have plans and specifications prepared by E. E. Sands, city engineer, for improvements at the central water plant. The specifications include deep well pumps, motors, generators, etc.

ORANGE, TEX.—National Shipbuilding Co. will construct an electric power plant at its shipbuilding yards here to cost about $100,000.

RANGER, TEX.—The city is considering plans for the installation of an electric lighting system. The local Chamber of Commerce is interested in the work.

WESTERN STATES.

GREAT FALLS, MONT.—Word has been received from Washington notifying Senator Walsh that the War Industries Board has reversed its ruling and sanctions the expenditure of $800,000 in the construction of a flour mill by J. F. Blecker, Ira Goodman and Charles Lewis at Broadus.

SALT LAKE CITY, UTAH.—B. Marcus Priteca, architect, Seattle, Wash., who has prepared plans for a 10-story theater and office building of fireproof construction at Salt Lake City, is asking for bids for the electric wiring and lighting fixtures, as well as for plumbing, heating and decorative plastering. This structure is for the Pantages circuit, headed by Alexander Pantages, Seattle. It is probable that other theaters of this class will be designed by Mr. Priteca for California.

SANDPOINT, IDA.—Energy for an additional 35 hp. in motors is now being supplied the Idaho Match Block factory by the Mountain States Power Co. The Copper Giant Mining Co. is considering the installation of an electrically-driven air compressor at its property near Clarksfork, which would require an initial installation of 35 hp. This would be supplied by the Mountain States Power Co.

CENTRALIA, WASH.—Construction will begin immediately on a line connecting the property of the Central Light & Manufacturing Co., at Pe Ell with the North Coast Power Co.'s lines at Meskill.

OLYMPIA, WASH. — Olympic Smelters, Inc., has commenced the installation of a hydroelectric plant at its manganese mines in the Olympic Mountains, in connection with two electric smelting furnaces. H. H. Piper is manager.

SEATTLE, WASH.—Nov. 18 the council at a meeting passed an ordinance providing for extensive additions and improvements in the municipal light and power plant, declaring the estimated cost of the improvements to be $1,775,000 and providing for the issuance and sale of negotiable bonds to that amount to finance the work.

SEATTLE, WASH.—Skinner & Eddy Corporation is considering plans for the erection of an electric smelter at its properties at Portland, Ore., estimated to cost in the neighborhood of $750,000. It is understood that electric energy for operation will be supplied from the municipal electric plant.

LOS ANGELES, CAL.—Recommendations have been made by Major George F. Sever, United States Army, special representative of the power section of the War Industries Board, for the early erection of hydroelectric power plants at various locations in northern California, to total about 118,000 kw. Included in the construction plans is a new generating station on Butte Creek by the Great Western Power Co., San Francisco, to have a capacity of 40,000 kw.; construction of a unit on the South Yuba-Bear river, development of the Pacific Gas & Electric Co., San Francisco; the erection of a hydroelectric power station by the Sierra & San Francisco Power Co., San Francisco, on the Stanislaus river; and the construction of a generating station by the Government at Sheep Rocks on the Pitt river, with a 110,000-volt steel tower transmission line to connect with the systems of the Sierra & San Francisco Power Co., the Pacific Gas & Electric Co. and the Great Western Power Co.

LOS ANGELES, CAL.—In connection with the proposed construction of power plant No. 2 in the San Francisquito canyon, preliminary plans have been prepared for the installation of the steel pipe line and penstock, estimated to cost in the neighborhood of $75,000. The Power Bureau of the Department of Public Service is in charge of the work.

RICHMOND, CAL.—New business secured by the Western States Gas & Electric Co., Richmond division, includes 12 kw. additional lighting load for the California Cap Co.

SACRAMENTO, CAL.—The city has rejected all bids received for the construction of the proposed electrically-operated pumping station at the municipal waterworks plant. It is understood that new bids will be asked at an early date.

SAN PEDRO, CAL.—Southwestern Shipbuilding Co. has had plans prepared for the construction of a new brick, steel and concrete transformer house at its works at East San Pedro.

WILLOWS, CAL.—The Princeton-Codora-Glenn Irrigation District is planning for the installation of new pumping plants in connection with its irrigation system. It is understood the structures will be electrically operated.

PROPOSALS

CONNECTORS, ELECTRIC FANS, CABLE, WIRE, ETC.—Bids will be received at the office of the General Purchasing Officer, the Panama Canal, Washington, D. C., until Dec. 11, for furnishing by steamer, free of all charges, on dock at either Cristobal (Atlantic port) or Balboa (Pacific port), Canal Zone, Isthmus of Panama, the following articles: cable, wire, watthour meters, electric fans, connectors, condulets and conduit. Circular 1241.

LAMP AND ACCESSORIES.—Bids will be received by the city of Chicago, Dec. 10, at Room 406, City Hall, for one 300-MM lamp and accessories for Wilson avenue crib, according to plans and specifications on file in the office of the Department of Public Works. Proposals must be made out upon blanks furnished at the above office and be addressed to said department indorsed, "Proposals for One 300-MM. Lamp and Accessories." Address Charles R. Francis, Commissioner of Public Works.

FIVE-PANEL SWITCHBOARD.—Bids will be received by the Commissioner of Gas and Electricity, Room 614 City Hall, Chicago, Ill., Dec. 9, for the manufacture, furnishing and delivery, complete, ready for installation, of a five-panel combination light and power switchboard, to the city of Chicago, Department of Gas and Electricity, strictly in accordance with specifications and blue prints on file in the office of the said commissioner. Proposals must be made out upon blanks furnished by the Commissioner of Gas and Electricity, be inclosed in sealed envelopes, addressed to him and indorsed "Proposals for Service Switchboard." Address William G. Keith, Commissioner of Gas and Electricity.

INCORPORATIONS

HORNELL, N. Y.—General Equipment Co. Capital, $50,000. To manufacture generating equipment, etc. Incorporators: A. R. Palmer, F. R. Serles, and H. G. Wenzel, Woodhaven.

OWENSBORO, KY.—Kentucky Electric Lamp Co. Capital, $100,000. To manufacture electric lamps. Incorporators: Roy Burlew, M. E. Pierson, and H. F. Coombs.

SUMMERVILLE, GA.—The City Light & Power Co. has incorporated with a capital of $7,500. Address John D. Taylor.

Recent Patents

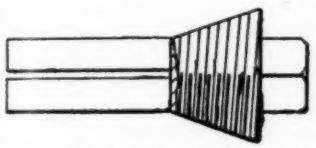
Selected and Summarized by Albert Scheible, Patent Attorney, 79 West Monroe Street, Chicago, Illinois

A series of brief comments on some of the recently issued electrical patents which appear to be of particular interest to our readers, the number after each heading being that of the United States patent to which the summary relates. Any correspondence regarding such patent matters should be sent direct to Mr. Scheible at the above address.

Primary Battery (1,282,057).—As a negative for an alkaline primary battery, Raymond W. Erwin (of Fremont, Ohio) uses a mixture of copper oxide and sulphur.

Gauze Brush (1,282,027).—To prevent a gauze brush from bowing or spreading its outer layers, Oliver E. Becker (of Becker Brothers, Chicago) provides fillings of tin only for parts of the brush, so as not to impair the natural resiliency and ventilation.

Magnetic Plug for Gear Casings (1,281,842).—To pick up particles of iron and steel which drop into gear cases, or which are worn off the gears, Samuel J. Rosnick and William Caigan (both of Lamberton, Pa.) use a plug which has its inner end split



No. 1,281,842.—Magnetic Plug.

into permanently magnetized poles. This plug is substituted for the ordinary plug closing the opening through which lubricant is supplied to the gears.

Looping Electric Cords (1,282,468).—To maintain any desired part of a flexible cord in the form of a loop or bight, George L. Scheel (of Chicago) uses a rubber band with buttons and slits near its ends, so that these ends can be secured to the cord.

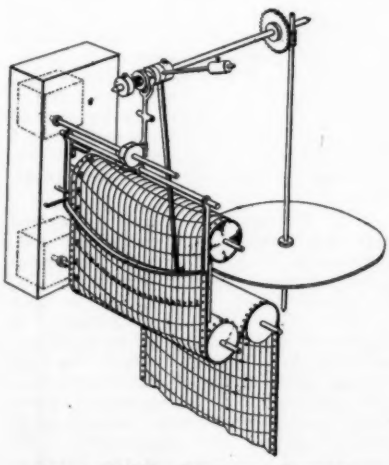
Electrolytic Depositing (1,282,259 to 1,282,270).—These twelve patents, all assigned by Matthew M. Merritt (of South Middleton, Mass.) to the Copper Products Co., of Boston, all relate to electrolytic and galvanoplastic processes and products. They include the making of copper tubes by depositing copper on a mercury-coated brass body and then enlarging the tube sufficiently by buffing, so that it can be slipped off the mandrel. Also, the electrolytic manufacture of manifolds and of airplane propellers.

Wattmeter (1,282,497).—In the wattmeter patented by Harold E. Trent (of Wilkinsburg, Pa.) an armature is rotatably mounted between the poles of a permanent magnet which normally is permanently shunted. This armature winding is supplied with current proportional to that traversing the circuit, while a potential winding is mounted on the magnet-shunting bridge and so opposes the shunting of the magnet that the magnetomotive-force drop between its poles varies in accordance with the potential of the circuit.

Slow-Acting Switch (1,282,123).—Current-conducting liquids in tiltable tubes are used in this switch, patented by Louis A. M. Phelan (of Chicago), one of the tubes being restricted so that the liquid can only move slowly from one end to the other.

System of Electric Heating (1,282,330).—Under this title, Tycho Van Aller (of Schenectady, N. Y.) describes a heating device in which the equal parts of an electrically continuous resistance element are connected in multiple to the supply circuit. It is especially adaptable to muffle furnaces. The patent stands assigned to the General Electric Co.

Maximum-Demand Recorder (1,279,378).—To reduce the load imposed by a recording mechanism on a watthour meter, so that it will not impair the accuracy of the meter, George D. Pogue (of St. Louis) connects the

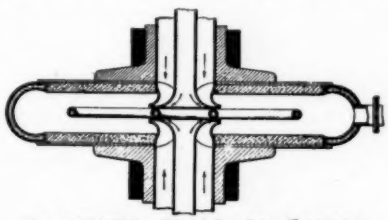


No. 1,279,378.—Maximum-Demand Recorder.

meter to an arm which normally swings clear of the record sheet. Then he uses separate means, such as the striking mechanism of a clock, for pressing this arm at certain time intervals against the sheet, thereby either puncturing or otherwise marking the latter.

Vacuum Cleaner (1,282,548).—In the appliance designed by Frank C. De Reamer (of Schenectady) the switch for the motor is mounted directly under the latter. This switch is controlled by a lever projecting back of the motor casing, so it can conveniently be reached by the foot of the operator. The patent was assigned to the General Electric Co.

Electric Arc Furnace (1,281,604).—In building a furnace for obtaining chemical reactions on gases by means of an electric arc, Anton V. Lipinski (of Zurich, Switzerland) uses a magnetic field for spreading the arc out into a sheet bounded by the elec-



No. 1,281,604.—Electric Arc Furnace.

trodes. Then he provides curved blades for imparting a revolving movement to the gas, thereby causing the sheet or disk of flame to rotate and hence avoiding an overheating of the electrodes at certain points.

Strain Insulator (1,281,849).—Two approximately half-tubular end-pieces each carry an eye. These end-pieces are surrounded by insulation and held together by two metal cups, the cups being secured to each other by a bolt which extends through the bore of the insulator. Patent assigned by William Schaake (of Pittsburgh) to the Westinghouse Electric & Mfg. Co.

Paper-Insulated Cable (1,282,208).—A strip of paper is impregnated with varnish diluted with benzine, and is allowed to dry. Then a conductor is covered with a body of porous material wrapped by such an impregnated strip, and insulating compound is applied to the wrapping at a temperature at which this compound will penetrate the impregnated strip and saturate the porous material.

Suspension Insulator (1,281,268).—With changes in temperature, damage may be caused by the difference in expansion and contraction between an insulator and the metal suspending cap which partly houses this insulator. To avoid this, Arthur O. Austin (of Barberton, Ohio) forms this part of the suspension cap with wavy sides and interposes a resilient material between these wavy sides and the edge of the insulator. The patent was assigned to the Ohio Brass Co., of Mansfield, O.

Personal

James M. Barry Joins Alabama Power — J. L. Finnicum Becomes District Manager of Electric Products—Changes

DAVID F. ATKINS has recently been appointed mechanical engineer for the Lord Electric Co., New York.

G. A. BINZ, sales manager of the Yarnall-Waring Co., Philadelphia, has transferred his headquarters to the company's New York office, located at 90 West street, and will devote his entire time to the interests of "Yarway" specialties in that territory.

R. R. SHEPHERD, formerly connected with the Chicago office of the Cutler-Hammer Manufacturing Co., is now electrical superintendent of the Steel & Tube Co. of America, formerly the Mark Manufacturing Co., Indiana Harbor, Ind.

J. A. RYAN recently severed his connection with H. Boker & Co., Inc., New York, to become one of the partners of the new firm of Champion & Ryan, manufacturers' representatives, with offices located at 299 Broadway, New York, N. Y.

C. L. DAUN, formerly a member of the firm of the Daun-Crawford Co., Saginaw, Mich., is now connected with the Electrical Machinery Co., distributor for the Howell Electric Motors Co., with headquarters at 200 First National Bank Building, Milwaukee, Wis.

C. B. AUEL, director of standards of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has been elected vice-president of the National Safety Council of Western Pennsylvania at the recent annual meeting of the organization held on Nov. 18 in the auditorium of the Chamber of Commerce, Pittsburgh, Pa.

I. H. MILLS, who has been associated with the Westinghouse Electric & Manufacturing Co., of East Pittsburgh, Pa., for the past 23 years, has resigned to become superintendent of the Sperry Gyroscope Co., of Brooklyn, N Y. Mr. Mills began his career with the Westinghouse as a machine operator, and finally became superintendent of the small industrial motor department.

JAMES M. BARRY has resigned as engineer of distribution for the Great Western Power Co., San Francisco, Cal., to become superintendent of the eastern division of the Alabama Power Co., with headquarters at Birmingham. Mr. Barry was identified with the installation of electrical equipment for the Noble Electric Steel Co. in northern California about ten years ago and for a number of years was designing electrical engineer for the Northwestern Electric Co. at Portland, Ore. While connected with the latter company Mr. Barry was in charge of hydroelectric plant and transmission-line work. He left the Portland company in June, 1914, to become chief of the department of electricity at San Francisco, which position he held until he joined the Great Western Power Co. last year.

C. W. WARD, laboratory superintendent of the Duquesne Light Co., has resigned to become superintendent of light and power of the Citizens Light & Power Co., of Oil City and Franklin, Pennsylvania.

BRIGADIER-GENERAL GUY E. TRIPP, chief of the Production of Ordnance Department for the Government, has just returned to Pittsburgh, Pa., to resume his duties as chairman of the board of directors of the Westinghouse Electric & Manufacturing Co.

ELLIOTT REID, for the past six years connected with the Westinghouse Lamp Co. in the capacity of advertising manager, has been appointed assistant to the general manager, Thomas G. Whaling. Mr. Reid was born in New York in 1889 and for three years was in the employ of the Equitable Trust Co.

CAPTAIN ANGUS S. HIBBARD, for 18 years vice-president and general manager of the Chicago Telephone Co., is now in France reorganizing the American Red Cross telephone system. The American Red Cross has found it necessary to furnish a complete telephone system for its work abroad.

FRANK J. MCNULTY, Newark, N. J., grand president of the International Brotherhood of Electrical Workers, who has just returned from Europe, was the principal speaker at a dinner given by the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., at the William Penn Hotel, on Nov. 22, in honor of the visiting delegates to the conference of consulting engineers.

GEORGE W. FULLER, New York, consulting engineer on the valuation board to take a physical valuation of the properties of the Pittsburgh Railways Co., Pittsburgh, Pa., has been appointed a member of the Federal commission to work out with similar commissions of the Allied nations for the rehabilitation of France, Belgium, and other countries.

J. L. FINNICUM, formerly connected with the Doubleday Hill Electric Co., Pittsburgh, Pa., is now district manager of the Electric Products Co., Cleveland, Ohio, with offices at 1064 Peoples Gas building, Chicago, in charge of district sales of its products, which include storage battery charging devices in the form of motor generator sets, rheostats of all capacities, automatic and non-automatic switchboards, vehicle motors and controllers. This company is a pioneer in the development of constant potential system for storage battery charging and in the development of automatic control for storage battery charging purposes. Mr. Finnicum was for seven years connected with the Doubleday Hill Electric Co., Pittsburgh, Pa., in the capacity of supply salesman and for the last two years has been manager of its industrial and power department.

J. W. REID has resigned as bridge engineer of the Chicago & Alton Railroad to enter the service of the Robins Conveying Belt Co., Chicago.

R. A. SARA, for many years sales manager of the city of Winnipeg (Man.) light and power department, has resigned that position to become connected with the American Cellulose & Chemical Manufacturing Co., of New York.

GEORGE B. MCNARY has resigned as director and secretary in charge of purchases of the F. Bissell Co., Toledo, Ohio, to accept an attractive position with the Willys-Overland Co. Mr. McNary is succeeded by John S. Huff.

P. B. NICHOLSON, purchasing agent for the Rockford & Interurban Company, has resigned that position to accept the general managership of the Standard Steel Car Corporation, Hammond, Ind.

THEODORE N. VAIL, president of the American Telephone & Telegraph Co., New York, has become personal adviser of Postmaster-General Burleson in the organization of the telephone-telegraph and cable systems.

ALLEN ASHLEY, of the New York district office of the Westinghouse Electric & Manufacturing Co., has resigned to take up export sales work with the Allied Construction & Machinery Corporation, 120 Broadway, New York.

BENJAMIN D. FULLER, superintendent of foundries of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has resigned to become vice-president and general manager of the Niagara Electric Furnace Co., the Defiance Paper Co. and the Niagara Wall Paper Co., of Niagara Falls, New York.

H. L. TREEMAN, industrial engineer for the J. G. White Management Corporation, New York, has been appointed manager of the electric department of the Eastern Pennsylvania Railways Co. and the Eastern Pennsylvania Light, Heat & Power Co., Pottsville, Pa., which are operated by the White corporation.

R. C. COFFY, manager of the Sapulpa Electric Co., Sapulpa, Okla., has been appointed publicity chairman for Creek county in the Red Cross Christmas membership drive. Mr. Coffy was also chosen one of five members composing an executive committee which arranged for a sane Peace Day demonstration on Nov. 11.

Obituary.

PERCY M. SCHENKEL, purchasing agent for the Brooklyn Electrical Supply Co., Brooklyn, N. Y., died on Nov. 6, at Plainfield, N. J., aged 30 years.

B. JENSEN, superintendent of the local works of the Empire Gas & Electric Co., Phelps, N. Y., was accidentally killed on Nov. 26. Mr. Jensen was 31 years of age.

Now that the War Is Won—What?

XIV.

President Wilson says:

"The problem of economic and industrial readjustment is less serious for us than it may turn out to be for the nations which have suffered the disarrangements and the losses of war longer than we. Our people do not wait to be coached and led. They know their own business, are quick and resourceful at every readjustment, definite in purpose, and self-reliant in action."

EXACTLY; but each company, firm and individual will have to act on their own initiative in recovering pre-war trade and gaining new. What are you doing?

C. A. Tupper, President . CHICAGO
INTERNATIONAL TRADE PRESS, Inc

Financial News

Tax Anticipation Certificates.

Aside from maintaining public order and the defense of life and property, the most vital function of Government is the provision of money, or an acceptable medium of payment and exchange. The financial needs of the Government, in war and after that for the restoration of the peace footing, are very large. Heavy taxation is necessary and the problem of meeting the Federal taxes without affecting the equilibrium of money and credits vital to the welfare of the nation. To meet the condition of raising $6,000,000,000 of taxes in 1919 the Government has decided on two policies: (1) Installment payment of the taxes on incomes and profits—the first installment falling due March 15. (2) The issuance of Tax Anticipation Certificates bearing 4½% interest and maturing at the time the taxes must be paid.

In effect the Tax Anticipation plan enables all who are liable for taxes to the Treasury to rally their cash means in the interval between Nov. 7, 1918, and March 15, 1919, and to invest that cash in a perfectly safe Government security, at a fair rate of interest, and in a form which will be accepted by the Treasury in tax payments March 15, 1919. Under this plan it will be possible to avoid any disturbance of the money market and credit conditions at the incidence of the enormous tax payments next spring.

The matter is thus summed up by R. G. Elliott, chairman War Tax Advisory Committee, National Association of Credit Men:

"We have been buying Treasury certificates in anticipation of taxes ever since it became apparent that the amount of revenue produced by the 1917 Act would be very large.

"War taxes are in the nature of a division of profits, with the Government in the position of a preferred stockholder who must be paid before there can be a distribution of profits to the owners; therefore provision should be made to cover this tax liability, the money withdrawn monthly or quarterly and invested in liquid form during the year in which the profit is earned.

"The Credit Men's Association, since the passage of the Excess Profits Tax Law, has advocated the serial payment plan and the creation of reserves by taxpayers; in other words, anticipating the payment by investment in certificates of indebtedness which will relieve the demand credit at tax-paying periods.

"These Treasury certificates furnish a convenient form of income-producing reserve and by investing in them during the taxable year to the extent of the tax liability, makes each year stand on its own bottom and will tend to defer the issue of bonds and permit an earlier reduction of war taxes for governmental expenditure, bringing us closer to home in our financing by reducing expansion, thus creating a sounder and more stable credit condition."

Municipal Service Finances.

In his latest annual report of "Financial Transactions of Municipalities and Counties of California," John S. Chambers, state controller, makes the following comments on municipal service enterprises:

"In a great many instances our municipal service enterprises do not provide for their bond interest and redemption from the revenue of the plant, but from a direct tax levy upon property. However, in the majority of cases such plants show a good earning power and all expenses should be met from the revenues derived from operation, with the possible exception of a large extension to serve an outlying population or lately annexed territory.

"In most instances, in municipally owned water and light plants, the rates are less or the service better than those of a private corporation, but a private corporation not only expects all expenses, including bond interest and redemptions and depreciation, to be met from the proceeds of operation of the plant, but also a substantial dividend.

"A municipal plant should not be expected to accumulate a large surplus any more than a city should collect excessive taxes for the purpose of establishing an unduly large reserve fund, nor should the plant be expected to raise revenue to be transferred, at the pleasure of the governing body, from that fund to some other for the benefit of some function foreign to it.

CITIES SERVICE COMPANY.

	12 months ending Aug. 31, 1918.	12 months ending Aug. 31, 1917.	Month of August, 1918.	Month of August, 1917.
Gross expenses	$21,661,286.24	$17,296,942.89	$1,696,059.92	$1,366,659.69
Expenses	422,095.87	320,588.86	54,325.35	30,809.46
Net earnings	$21,238,190.37	$16,976,354.03	$1,641,734.57	$1,335,850.23
Interest on debentures	52,240.89	3,264.32	31,818.74	225.68
Net to stock	$21,185,949.48	$16,973,089.71	$1,609,915.83	$1,335,624.55
Dividends preferred stock	3,998,720.50	3,422,371.65	336,795.00	325,370.00
Net to common stock and reserves	$17,187,228.98	$13,550,718.06	$1,273,120.83	$1,010,254.55
Debenture fund				$ 615,988.47
Contingent fund				820,782.50
Stock surplus				3,113,188.25
Surplus reserve				4,850,786.94
Surplus				23,605,606.53
				$33,006,352.69

DAYTON POWER & LIGHT.

	October.		10 months ended Oct. 31.		12 months ended Oct. 31.	
	1918.	1917.	1918.	1917.	1918.	1917.
Gross earnings	$218,689	$174,388	$1,902,457	$1,486,280	$2,296,796	$1,815,680
Operating expenses (including depreciation and taxes)	153,231	112,892	1,331,112	1,003,288	1,594,369	1,256,121
Net earnings	$ 65,458	$ 61,496	$ 571,345	$ 482,992	$ 702,427	$ 559,559
Non-operating revenue	2,599	1,257	26,236	8,745	27,824	10,258
Total income	$ 68,057	$ 62,753	$ 597,581	$ 491,737	$ 730,251	$ 569,817
Interest on bonds	$ 32,192	$ 15,121	$ 289,127	$ 151,379	$ 319,368	$ 181,787
Other deductions (includes other interest and sinking fund)	12,498	9,950	118,547	101,324	141,581	119,312
Total deductions	$ 44,690	$ 25,071	$ 407,674	$ 252,703	$ 460,949	$ 301,099
Net income	$ 23,367	$ 37,682	$ 189,907	$ 239,034	$ 269,302	$ 268,718
Dividends on preferred stock	15,219	14,813	148,900	148,125	178,525	177,750
Surplus	$ 8,148	22,869	$ 41,007	$ 90,909	$ 90,777	$ 90,968

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid Nov. 26.	Bid Dec. 3.
Adirondack Electric Power of Glens Falls, common	6	14	14
Adirondack Electric Power of Glens Falls, preferred	6	69	69
American Gas & Electric of New York, common	10+extra	100	103
American Gas & Electric of New York, preferred	6	43	43
American Light & Traction of New York, common	..	238	229
American Light & Traction of New York, preferred	6	102	100
American Power & Light of New York, common	4	55	55
American Power & Light of New York, preferred	6	74	74
American Public Utilities of Grand Rapids, common	..	10	..
American Public Utilities of Grand Rapids, preferred	7	38	38
American Telephone & Telegraph of New York	..	104	103¾
American Water Works & Elec of New York, common	..	7	7
American Water Works & Elec. of New York, particip	7	14	14
American Water Works & Elec. of New York, first preferred	..	65	65
Appalachian Power, common	..	2	2
Appalachian Power, preferred	7	10	10
Cities Service of New York, common	+extra	296	292
Cities Service of New York, preferred	6	82	81
Commonwealth Edison of Chicago	8	118	116
Comm. Power, Railway & Light of Jackson, common	..	23½	23
Comm. Power, Railway & Light of Jackson, preferred	6	51	49
Federal Light & Traction of New York, common	..	9	9
Federal Light & Traction of New York, preferred	..	39	39
Illinois Northern Utilities of Dixon	6	..	..
Middle West Utilities of Chicago, common	2+extra	27	27
Middle West Utilities of Chicago, preferred	6	57	56
Northern States Power of Chicago, common	..	64	60
Northern States Power of Chicago, preferred	ex.div.7	86½	86
Pacific Gas & Electric of San Francisco, common	..	40	40
Pacific Gas & Electric of San Francisco, preferred	6	84	85
Public Service of Northern Illinois, Chicago, common	7	95	92½
Public Service of Northern Illinois, Chicago, preferred	6	88	88
Republic Railway & Light of Youngstown, common	4	18½	18½
Republic Railway & Light of Youngstown, preferred	6	57	57
Standard Gas & Electric of Chicago, common	..	10	11½
Standard Gas & Electric of Chicago, preferred	6	33	32
Tennessee Railway, Light & Power of Chattanooga, common	..	3¼	3¼
Tennessee Railway, Light & Power of Chattanooga, preferred	6	16	16
United Light & Railways of Grand Rapids, common	4	39	38
United Light & Railways of Grand Rapids, preferred	6	72	72
Western Power of San Francisco, common	..	14	14
Western Power of San Francisco, preferred	6	60½	60½
Western Union Telegraph of New York	extra	87	88
Industrials—			
Electric Storage of Philadelphia, common	4	51	51
General Electric of Schenectady	8	148	154
Westinghouse Electric & Mfg. of Pittsburgh, common	7	42	43¼
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	60	60